The Dock and Harbour Authority

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Editorial Comments

A Notable Northern Port.

Among ports in northern latitudes, Helsingfors, or in the native tongue of the inhabitants, Helsinki, occupies a leading position. The 60th parallel of latitude serves to mark, in a general way, the northern limit for the major ports of Scandinavia, for just on or near this line lie the ports of Bergen and Oslo in Norway, Stockholm in Sweden, Helsingfors and Abo in Finland, and Leningrad in Russia. The line passes westwards to the British Isles, a little short of the Orkneys. In such a situation, within 6½ degrees of the Arctic Circle, the conditions in winter are naturally rigorous, and the Port of Helsingfors is kept open largely with the aid of ice-breakers. Work is, of course, occasionally suspended for longer or shorter periods, but such intermissions are becoming rarer and shorter as more powerful and effective appliances are rendered available, and the new port ice-breaker, "Otso," now in service, has proved a valuable adjunct to the State fleet of ice-breakers engaged on work in the outer waters. We have not, however, had an opportunity of seeing Helsingfors in the grip of winter, our impressions being those of a visit paid in the month of August, when the climatic conditions were as mild and genial as could be desired.

Prior to the Great War, the chief product and export of Finland was (as it continues to be) timber and its derivatives, and this was carried chiefly in sailing vessels, which did not make very exacting demands on the harbour accommodation then available. Mechanically-propelled vessels only began to take a prominent part in Finnish water-borne trade subsequent to the second decade of this century, and with the advent of larger and deeper draughted vessels, the necessity for harbour improvements became imperative. The authorities at Helsingfors have not been slow to recognise this fact, and they have energetically embarked on a programme of improvements of a very extensive character, as regards part of which, then in progress we had ocular evidence on the occasion of our recent visit. The description of the operations in hand and of the further expansion contemplated, which Herr S. Randelin, the Harbour Engineer, has been so good as to prepare, will convey an excellent idea of the enterprise and initiative which are being displayed by the Port Authority.

A notable feature of modern traffic at the port is the increase in coal and coke imports. There are no geological coal deposits in Finland, and all supplies have to be imported. In spite of this drawback, coal consumption in Finland is steadily gaining ground. Some 1,400,000 tons were imported in 1936, as compared with a million tons in 1935, in addition to which there were nearly 300,000 tons of coke. The consumption of timber and waste from wood-working industries is decreasing, and coal is gradually taking the place of vegetable fuel, principally in the ports and coast towns, but also inland.

Helsingfors as a city is a pleasing combination of business activities and residential amenities. It contains many fine buildings, largely in the modern style, and its shops and stores would be a credit to any important metropolis. We noticed indications on all sides of development and expansion, quite apart from the increase in the harbour accommodation and quayside facilities. Building operations were in progress in accordance with a town-planning scheme, in which a projected central esplanade, designed by the Finnish architect, Oiva Kallio, presents an appearance at once dignified and impressive. As the capital and chief port of Finland, Helsingfors occupies a deservedly prominent position in Northern waters.

Damage to Harbour Works by Marine Organisms.

For centuries past, harbour engineers have been troubled by the ravages of organisms, both crustaceans and molluses, which have attacked and rapidly destroyed timber structures in a marine environment. The ravages by what is commonly known as the "shipworm," and, technically as "Teredo," with others of the family "Teredinidae," have been evident from the earliest days of navigation, and these pests are recorded to have proved a source of disaster during one of the voyages of Columbus when his ships were "pierced with wormholes like a beehive!" The damage done to timber piling at the present day in various parts of the world can hardly be estimated at less than millions of pounds. In most maritime countries, investigations have been proceeding for some time to ascertain the habits and characteristics of these organisms, the nature of their attacks, the susceptibility of various timbers and the periods during which attacks are most prevalent. In Great Britain, the matter formed the subject of part of a report recently published by the Department of Scientific and Industrial Research, embodying the information obtained and the conclusions arrived at as the result of an enquiry by a Special Committee extending over some fifteen or sixteen years. Similar investigations have been, and still are, in progress in the United States.

Harbour Engineers will welcome, therefore, the appearance of a report by the Marine Service Board of New South Wales, which is supplemental to an earlier report on the Destruction of Timber by Marine Organisms in the Port of Sydney, published in 1932. In the current issue of this Journal we publish an instalment of this supplemental report, which covers the years 1932-34, and shows strangely contrasting results in the experience from two widely distant points in the harbour. In the one case, the greatest intensity of attack is found to have persisted throughout three or four months from November to February, while in the second case the preponderant attack occurred during the month of August. Such diversity of results is perplexing, especially when complicated by the further fact that the predominant agency was in one case the "Teredo," while in the second case, it was crustaceans ("Limnoria," "Chelura," etc.). There is clearly a good deal more ground to be covered before the whole of the governing factors have been ascertained, and it is not surprising that, so far, no specific antidote has been found. The Romans are alleged to have discovered a species of wood which is immune from attack, but if they did, their secret is lost, and, so far as present knowledge goes, there is no timber which is indubitably free from liability to attack. Hence the importance of the researches now in progress.

Bar Dredging.

The continued increase in the loaded draught of cargo vessels in recent times has proved a source of perplexity and concern to many port authorities, in regard to the maintenance of ready and convenient accessibility, often in the face of difficult tidal conditions, to quays and docks located on estuaries or rivers afflicted with bars at their mouths. Few river ports are entirely exempt from physical drawbacks of one kind or another, arising out of the inherent conditions and natural processes of accretion and deposit. In order to cope with the problem, recourse has been had to dredgers of powerful calibre for the purpose of excavating and maintaining deep-water channels through the shoals and sandbanks which impede the entrances of such rivers. A notable example which

Editorial Comments—continued

has been in existence since the first decade of the present century, and still maintains supremacy in size and power, is the "Leviathan," built for the Mersey Docks and Harbour Board for work on the bar at the mouth of the Mersey, and capable of raising 10,000 tons of sand in the space of fifty minutes. In more recent years, there have appeared the "Pierre Lefort," which has been engaged on the formation of the Great West Pass at the mouth of the Gironde, and, more recently still, the "Chien She," commissioned for the Yang-tse River bar by the Port Authority of Shanghai, and designed by their former Engineer-in-Chief and present Consultant, Dr. Herbert Chatley. Another dredger of similar design and capacity is now in course of construction for the same port.

The detailed description on page 278 of the "Chien She," for which we are indebted to Dr. Chatley, illustrates a number of modern features in dredger design, and demonstrates the progress which has been made in recent years on harbour plant for deepening operations.

Import Duties Advisory Committee.

It would hardly have come within the province of this Journal to comment upon the Report of the Import Duties Advisory Committee, which was issued in the early part of July, and certainly not to discuss the particular difficulties and problems of the iron and steel industry which were the subject of investigation, were it not for the fact that the report contains a reference to matters which directly affect certain port authorities. The reference is general in terms and not specifically directed to any particular quarter. Notwithstanding this official reticence, however, it is not difficult to infer that the allusion must fall within the range of the groups of ports on the North-East and South Wales coasts. Naturally, the complaints will have to be fully defined and localised if an inquiry, such as foreshadowed, materialises.

The passage, which we transcribe from the report, is as follows: "The [British Iron and Steel] Federation has also drawn our attention to the alleged inadequacy of the dock facilities and equipment at some ports and the great variation in methods and scales of charges at the different shipping points. Here, again, owing to the practical necessity of limiting our inquiry, we have not investigated the position, and in the absence of evidence from the interests concerned with the provision of such facilities, are unable to express any opinion on the position. But in view of the volume of ore and scrap imported by the industry, it is obviously of importance that up-to-date facilities for docking and unloading the largest ships used for this purpose at reasonable charges should be available, and we commend to your consideration the suggestion of the Federation that an independent inquiry should be made into the existing facilities and charges, and the steps, if any, needed to bring them into accord with modern conditions."

There is something in the passage which is reminiscent of earlier complaints of a similar character emanating from the Chamber of Shipping of the United Kingdom, which led to the formation by that body of a Special Committee of investigation, the two reports of which were published in succession, in 1924 and 1929, under the title of "Port Facilities of Great Britain." These reports, based on visits paid to some 70 or 80 ports on the seaboard of Great Britain, contained a series of detailed observations and recommendations, local in scope and effect, which, no doubt, received the consideration of the authorities concerned. The Visiting Committees found that, generally speaking, the port authorities were fully alive to the needs of shipping interests, and that in many cases improvements were in hand to secure more efficient port working. The same conclusion may possibly be arrived at in the present connection.

Port Labour.

The introduction of the 40-hour week into the operation systems of French and Belgian ports will be watched with considerable interest by port authorities on this side of the English Channel. So far as can be gathered from occasional references in the foreign press, the experiment has not been altogether an unqualified success from the employers' point of view. We learn in the case of one French port, that returns show a definite decrease in the effective rate of labour under the new conditions, the weight of goods handled per man per hour having appreciably fallen under the new system, as compared with the old. A singular and unexpected addendum is that even with the reduced rate and period of working, there are now more accidents than formerly. Whether this is the result of carelessness induced by a sense of indifference and slackness, it is difficult to say, but the fact has been noted. It is certainly common experience of human nature that when energies are not kept up to "concert pitch," they are apt to become flaccid and the mind less alert to respond to sudden emergencies when they arise.

The Quarterly Shipbuilding Returns.

The statistics issued by Lloyd's Register of Shipping regarding Merchant Vessels under construction at the end of June last show that in Great Britain and Ireland there is an increase of 185,519 tons in the work in hand, as compared with the figures for the previous quarter. The present total of tonnage under construction—1,199,973 tons—exceeds by 351,241 tons (or more than 40 per cent.) the tonnage which was being built at the end of June, 1936, and is the highest quarterly total recorded since June, 1930. It exceeds considerably the aggregate tonnage now under construction in the four leading countries abroad.

The situation revealed by the foregoing return would be satisfactory enough but for one significant fact. We believe that British shipbuilding firms, while busy enough on home commissions, are concerned at the lack of orders from abroad. Whereas in former times many foreign commissions found their way to British shipyards, an increasing quantity of foreign tonnage is now built abroad. In a field where in the past British builders, if they did not monopolise the output at any rate, unquestionably dominated the market, the supremacy of British skill and workmanship is being challenged, and the stress of alien competition is making itself felt under conditions of labour abroad, which are often more favourable than those of this country. The prospect of further losses in this direction is disquieting.

Trade and Navigation Returns.

In recent public utterances the Prime Minister has avowed his confidence that the present improvement in trade is not merely a transitory phase or "boom," the precursor of a near and corresponding depression, but that it represents a reliable and steady movement on the upgrade of national advancement towards a durable state of commercial prosperity and public welfare. It is true that he safeguarded his opinion with a fundamental proviso about world peace and security, and the absence of disturbing agencies, but, none the less, it was welcome and reassuring to have this declaration of faith by a statesman whose speeches have always been characterised by restraint and cool judgment.

The reports that come to hand from official sources, relative to the position at the leading ports of the kingdom, are all in accord with the Prime Minister's pronouncement. Progress is no longer intermittent: it is continuous and reasonably uniform The unbroken upward trend has been in evidence for an appreciable period of time.

The accounts of the trade and navigation of the United Kingdom for June, issued by the Board of Trade on July 14th last, show that the values of imports and exports are the highest since the end of 1930. The total value of imports was £88,116,677, as compared with £67,599,397 in June last year. Exports this June are valued at £44,373,015, as compared with £32,064,534 twelve months ago. Re-exports at £7,126,952 showed an increase of £2,118,913 over the return for June, 1936.

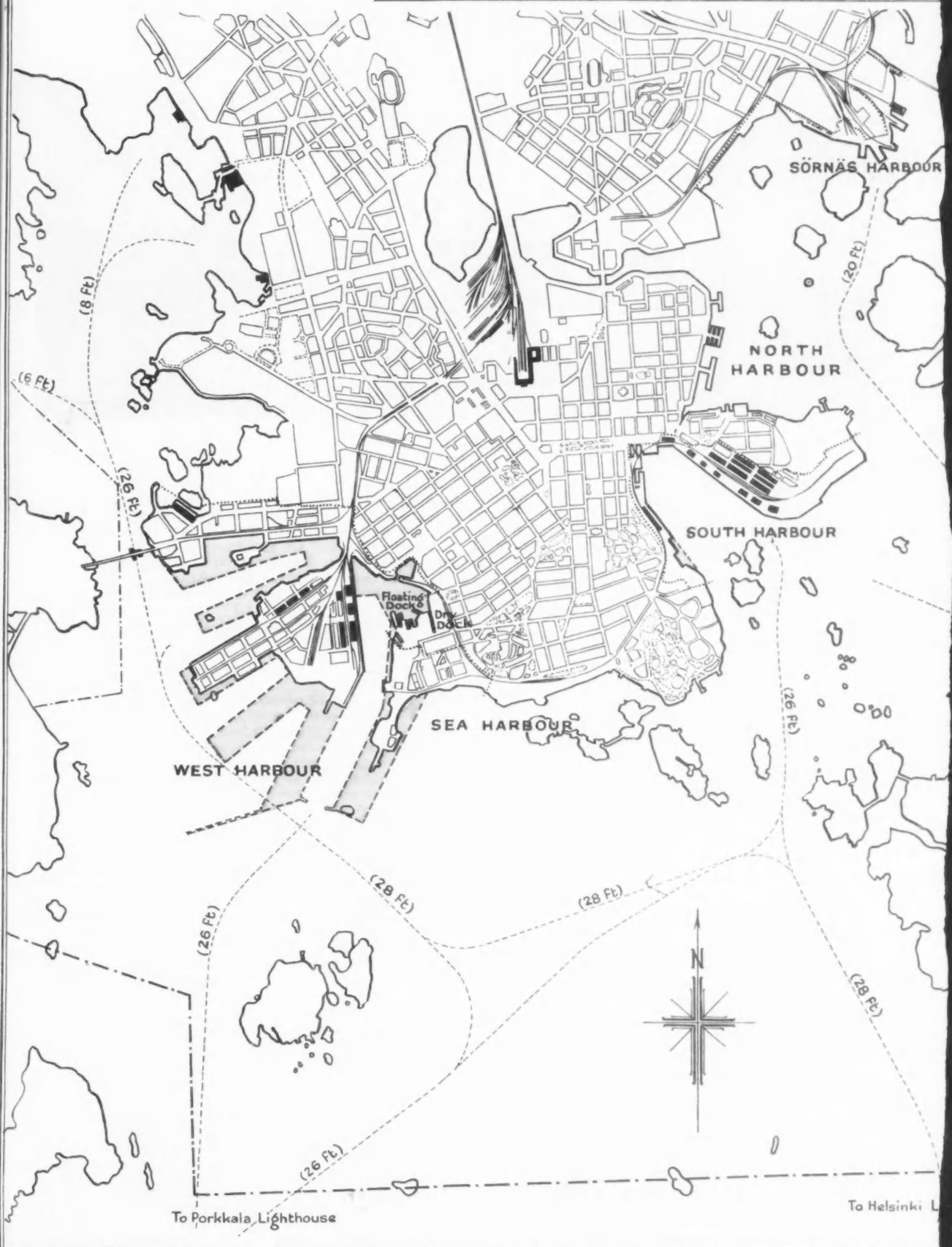
Coal shipments for June amounted to 3,482,340 tons, valued at £3,289,863, as compared with 2,574,365 tons, worth £2,154,485 in June, 1936. Coal shipped for the use of steamers, etc., engaged in the foreign trade (including fishing vessels) totalled 966,783 tons, against 902,134 tons in June, 1936. There has been a notable revival during the current year in coal exports to Italy, and it is a little unfortunate that the Secretary for Mines should have felt it necessary the other day to issue a warning that the available margin of credit in the Anglo-Italian Clearing Office may not suffice for further purchases this year.

In regard to shipping entrances and clearances, the same tale is told. The net tonnage of vessels entered and cleared with cargoes at ports of the United Kingdom in May, 1937, aggregated 6,789,666 for British vessels in June, 1937, as against 6,240,261 in June, 1936; for foreign vessels the figures are respectively 4,944,710 and 4,567,582.

The cumulative effect of these statistics is impressive. That they are confined to the field of navigation and overseas commerce does not in any way weaken the argument, though, if necessary, figures from other departments of trade could be adduced in support. It is obvious that port activities are a reliable indication of the commercial position of a country like Great Britain, for which there must be an active circulation of trade and traffic with foreign countries to ensure a satisfactory balance sheet in home finance. Britons cannot, like the inhabitants of Mark Twain's island, live by taking in one another's washing. Interchange of commodities and manufactures with those of other nations is essential. So long therefore, as the stream of imports and exports continues to increase, the nation may look forward hopefully and take courage.

PORT OF HELSINKI – H

HERR S. RANDELIN, HARBOUR ENGINEER, HARBOUR OFFICE,

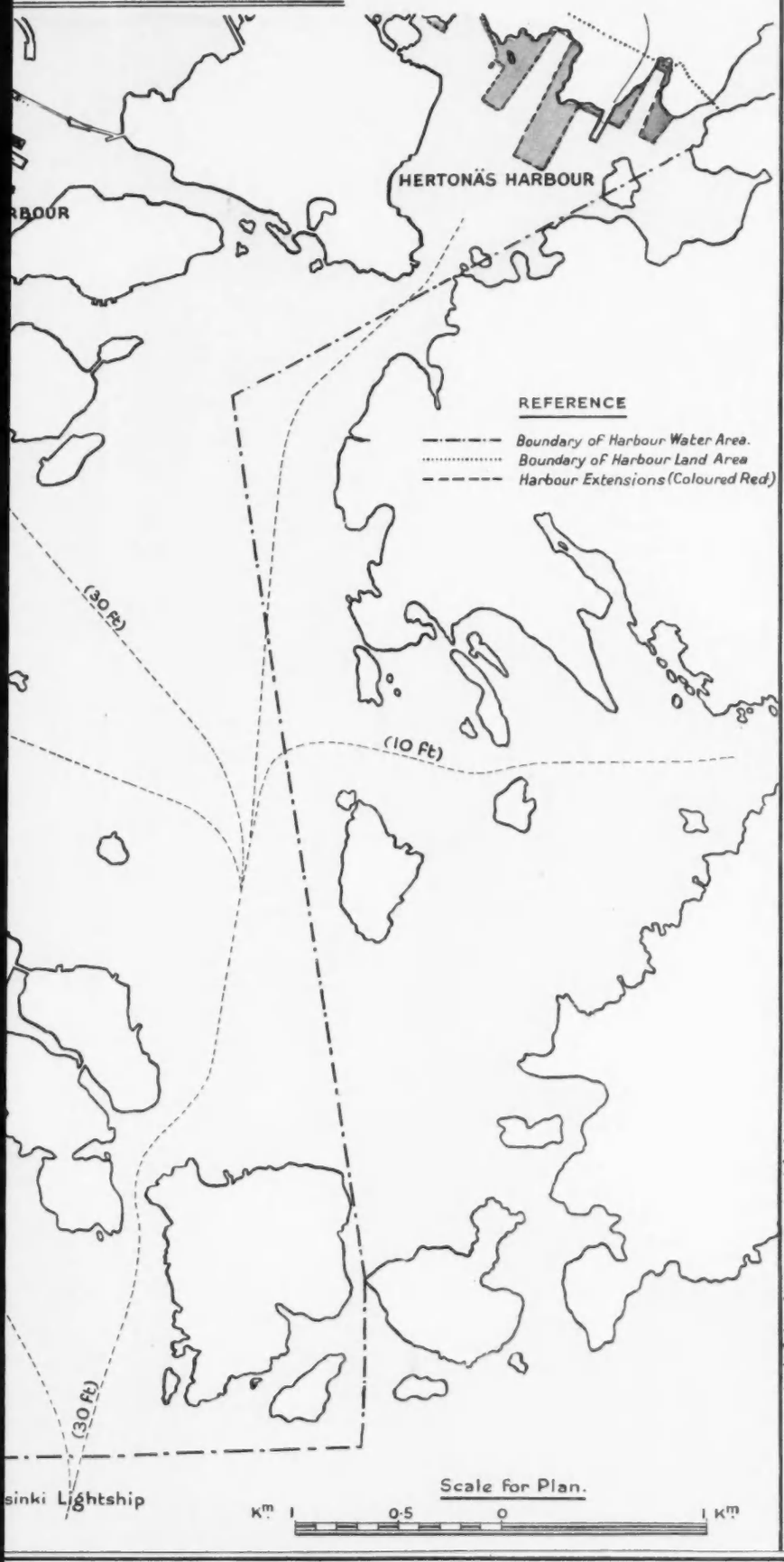


WARD & FOXLOW, LITH

AND HARBOUR AUTHORITY, AUGUST, 1937.

HELSINGFORS.

FICE, HELSINGFORS, FINLAND.



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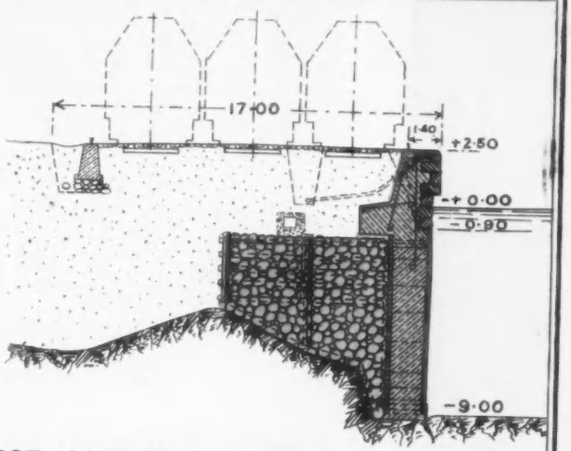
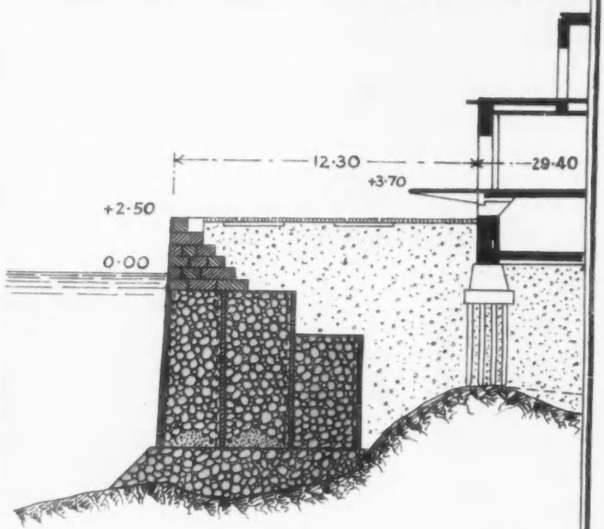
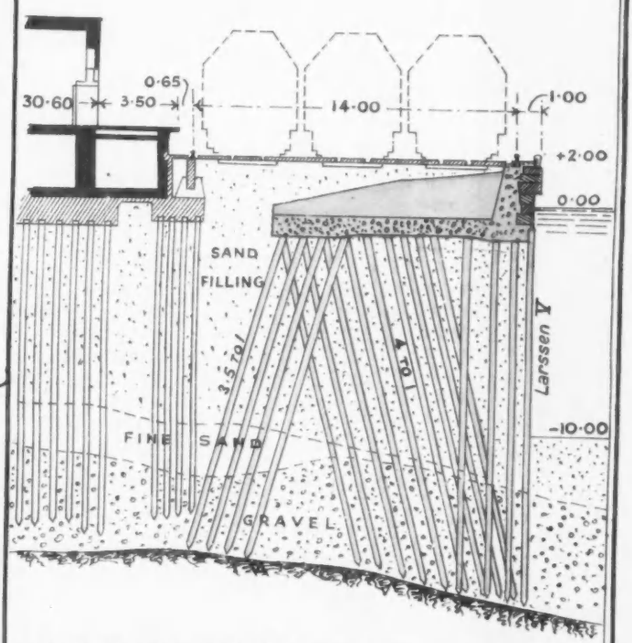


WEST HARBOUR — NEW QUAY SECTION.



WEST HARBOUR — QUAY SECTION.



SOUTH HARBOUR — QUAY SECTION.

The Port of Helsinki (Helsingfors)

The Great Metropolis of Finland

By S. RANDELIN (Chief Engineer) and W. WESTERHOLM (Assistant Engineer)

View of South Harbour.

Historical

NOWADAYS, more than ever, the life and development of the small nations depend on their communications with the rest of the world. Finland, which is bounded for a third of its frontier by the Gulfs of Finland and Bothnia, has possibilities of producing such connections by sea. Therefore it is natural that in the course of time, many important harbours for commerce at home and abroad have grown up along its extensive coast. To a special importance have developed those ports which have been in the vicinity of industrial and commercial centres or transport routes for the most significant export products of the country, namely, wood and wood by-products in various forms, such as paper, pulp, plywood, etc.

The most important port is Helsinki (in Swedish Helsingfors), the capital of Finland, which is in a central position on the south coast. It is the largest and technically best-equipped port with deep-water quays, warehouses and crane facilities for handling cargo. About 50 per cent. of the total imports of the country is handled in Helsingfors, and its value is now annually about 2.7 milliard marks. As regards exports, the city last year held the second position with 12 per cent. of the country's total exports. The amount of shipping tonnage entering the port in 1936 was over 2 million registered tons, of which 1.7 million tons were foreign.

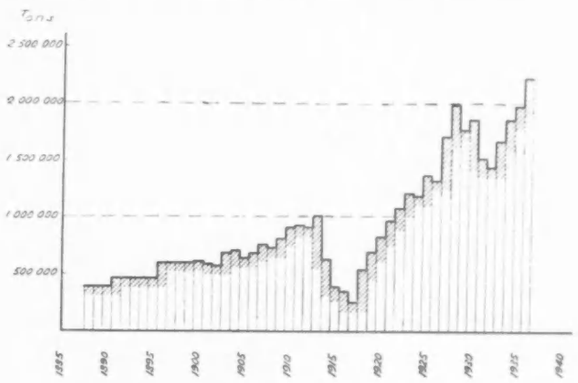
Helsingfors is also the first passenger port of the country, and has many direct shipping lines with European and trans-ocean ports. With Great Britain there have been for many years regular services, which show satisfactory development. The most important ones are to London, Hull, Liverpool, etc. Other regular routes are to Scandinavia, the Baltic States, Germany, Belgium, France, the Mediterranean countries, and some ports in North and South America.

The town of Helsingfors can trace its origin from 1550 A.D., when it was founded by the King Gustavus Wasa. Originally, the town was planned to be built at the mouth of a small river, but was later, 1639, moved farther out toward the Gulf to a peninsula, which was to be the centre for future development. But the growth of the town was for a long time very slow and retarded by reason of wars and restless conditions in the country, and perhaps also partly because of the rivalry of Reval on the opposite side of the Gulf of Finland. In the year 1749, the fortification of the islands outside the town was begun, and the naturally good harbour was rendered capable of an important military function. It was only after the connection with Russia, 1809, that political conditions became calmer and the town began to develop more rapidly. In the year 1912, Helsingors was created the capital of Finland.

After the Russian revolution Finland declared its independence in 1917, and became in 1919 a republic. Since that time Helsingfors has grown at a very rapid rate, and has developed into a quite modern town with residence for the President, seat for the Diet, the Cabinet and other central Government offices. The town is, furthermore, the centre of the economic and cultural life in the country. It has at present about 290,000 inhabitants and is autonomous, having a City Council of 59 members.

As the city extended its limits, commerce and shipping increased, and new industries in the town and its neighbourhood began to develop. This resulted, furthermore, in a rapid expansion of the harbour.

The first harbour works were probably built shortly after or perhaps before the actual foundation of the town. The type of wharf which prevailed for a long time was small and of a simple construction. Not until the 18th century was the normal type of quay construction built, first in the present South Harbour and later in Sörnäs Harbour. A new period in the development of the harbour began in 1895, when the harbour railway was built and connected with the National railway system. In consequence, the harbour came into much greater importance, and gained possibilities for further development. From this time dated the first important and consecutive harbour projects to be planned, and the programme of future harbour construction, was laid down. The principal works were carried out in the South and West Harbours which, since then, have been the town's main harbours. The new Hertonäs project and the railway connection to this harbour, which at present is under construction, dates from a later period.



Development of the Shipping Trade, 1887-1936.

Helsingfors had, in 1878, 677 lin. m. of quayage or, more correctly, wharfs and piers, with a water depth of more than 3 m. In 1936, the available length was about 5,000 m., and if all smaller piers and landing stages are included, about 8,000 m. The town has, furthermore, many warehouses with a total floor area of about 109,000 sq. metres and 38 cranes, of which 7 are large gantry cranes for the coal harbour. The length of the railway lines in the harbour is about 43,000 m. The development of the port is illustrated by the diagrams.

Port of Helsinki (Helsingfors)—continued

View of West Harbour.

Entrances to the Port

Helsingfors, with its harbour, is like large sections of the Finnish coast, particularly in the south and south-west, well sheltered by an extensive archipelago, with low cliffs and islands separated by deep channels. For navigation, it is therefore important that the routes be well defined by means of spar-buoys, lighthouses, pilot stations, etc.

For the larger class of vessels there are two entrances from the Baltic. The most important and shortest of these leads to Helsinki lightship in the middle of the Gulf of Finland, where the course is diverted north to the Grahara lighthouse, on a little cliff, and by the beautiful Gustavsvärds Sound into the harbour. The last-mentioned sound is bordered by old forts rich in historical memories, the thick and mighty stone walls of which are interesting exponents of the art of fortification two hundred years ago. It was these forts that the English navy, under Admiral Napier, bombarded in 1855. The channel of this entrance is dredged to 9.1 m. below mean water level.

The second entrance comes near the coast by Porkala lighthouse and pilot station, about 25 miles from Helsingfors, and the fairway leads from this place eastward along the coast. The route is landward, bordered by an archipelago, which in summer-time is of the most fascinating beauty. In winter-time, when the ice conditions in the Gulf are troublesome, traffic is maintained along this route. The channel of this entrance is dredged to 7.9 m. below mean water level.

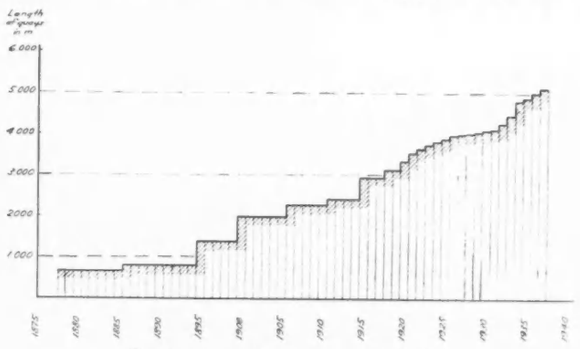
Besides these approaches from the west, there are also deep channels from the east and, in addition, shallow coast routes.

Tidal and Ice Conditions

The variation of water level on the Finnish coasts, except in the Arctic Ocean, are practically imperceptible. The existing variations depend on other than tidal conditions, the barometric pressure and the dominating winds and their strength. During west and south-west winds the water is driven from the Baltic Sea into the Gulfs, which results in a raising of the water level. The highest observed level in Helsingfors is 1.27 m. above a specific zero level, which approaches mean sea level. The lowest depth which has been observed is on the contrary 0.85 m. below mean sea level. The greatest variation under unusual conditions is thus from + 1.27 to —0.85. The relatively small and slowly altering changes in the water level make it possible to use open harbours without impounded docks.

A matter of importance in projecting maritime works in Finland is the gradual rising of the level of the land. On the south coast this rate is from 2.5 to 5.0 mm. per annum.

In winter, when the coasts of the Gulf of Finland are covered with ice, sea routes are kept open by ice-breakers. Helsingfors owns two small vessels, which render assistance in the harbour. Farther out, the vessels are assisted by powerful ice-breakers belonging to the Government. Ice formation begins commonly towards the end of December and in February and the beginning of March the conditions can be very severe. Furthermore, navigation to the east coast ports having ceased, the traffic to Helsingfors is thereby augmented. From 1910 to 1937, the traffic has, during 16 winter seasons, been kept in movement the whole time, and during other years stopped sometimes for a few weeks only, sometimes for two months. It is planned to make the ice-breaker fleet so large that Helsingfors can be kept open during the whole year, even when the ice conditions are at their worst. With unfavourable winds and consequential pack ice zones, vessels have to take the inner fairway via Porkala.



Development of Quays from 1878-1937.

Railway Conditions

The Port of Helsingfors is, as already mentioned, connected with the goods railway station of the city, which is a terminus for important railway lines running inland to the north, to the eastern frontier and to the west along the coast.

The harbour railway makes in its course a wide circuit, and from this line the quay and warehouse tracks branch out. Sörnäs Harbour has a separate line, and Hertonäs Harbour, which is under construction, has just been connected with the State system. The total length of the railway lines in the port is about 43 km.

Traffic Region and its Potentialities

Being the largest town in Finland and the capital of the country, Helsingfors is an important point of consumption and

The Port of Helsinki (Helsingfors)

View of Coal Harbour with the Gantries and Cranes for unloading Coal.

View of West Harbour with the Floating Dock and Shipyard described in the article. On left, some icebreakers.

Port of Helsinki (Helsingfors)—continued

distribution, and for its own needs alone requires important harbour traffic. The city is, furthermore, an important industrial centre. In its administrative area there are more than 500 industries, employing about 20,000 workers, excluding the constructional industry, which employs a great number of workers. The amount of the annual production in Helsingfors is about 1.6 milliard marks.

The traffic region reaches, however, far into the country. With excellent railway accommodations and an extensive highway system, the town is in connection with inland towns, industrial centres and fertile agricultural areas.

Helsingfors is also, as mentioned, the first port of the country in so far as passenger traffic is concerned. Especially for pleasure cruises in the Baltic, which during recent years have become very important, Helsingfors has been a favourite port of call.

The Administration of the Port.

The Port of Helsingfors, excluding some warehouses and crane facilities, is the property of the city. The port is managed by the Harbour Board, which is composed of a chairman and six members, elected by the City Government. The Harbour Board is assisted by the General Manager. Under his supervision are two departments, namely: The Harbour Office, under the Captain of the port, and the Harbour Accountant's Office. All projects are designed and constructional works carried out by the Harbour Department, which belongs to the Board of Common Works. The scheme of administration of the port will be seen in the diagram.

The Helsingfors Warehouse Company, in which the city at present holds the majority of the shares, owns most of the warehouses in the harbour, and the up-to-date crane equipment in the West and Coal Harbours. The Company had last year 92,563 sq. m. of storage accommodation. Goods can be stored for a period of two years without previous custom inspection or control. These warehouses thus have free port privileges.

The Harbour Area and Harbour Works

Helsingfors Harbour area, that is the water and land area and harbour works, which forms the Port of Helsingfors, and where the harbour dues and statutes are in force, is shown in the Supplement. The water area is about 7,769 ha and the land area 77 ha.

The harbour works are located in the centre of the town or in its immediate vicinity. The new oil and industrial harbour, however, will be built some distance away.

The ordinary basins or harbours, available for sea traffic, are the following:—

South Harbour

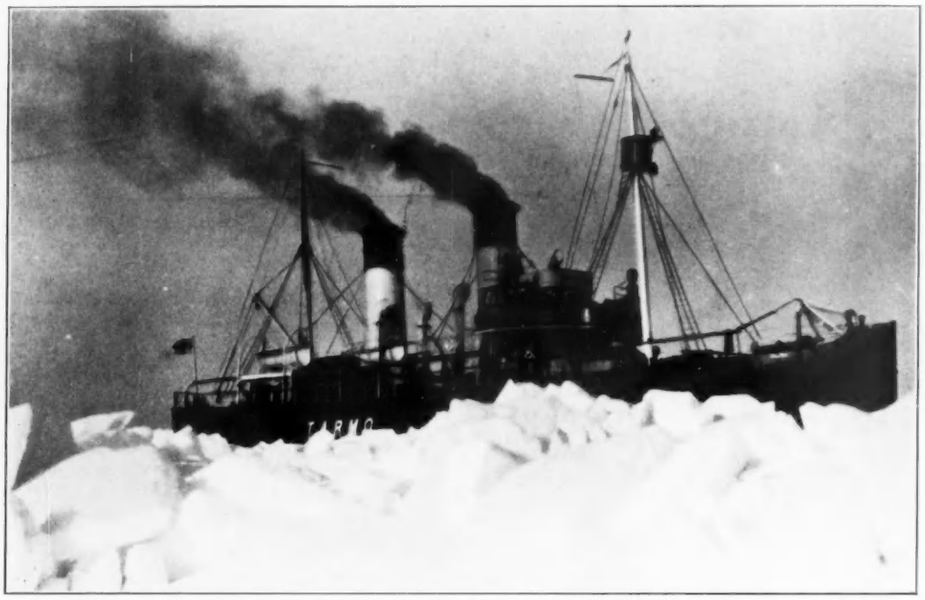
This is the oldest section, which penetrates into the centre of the town. It is the main passenger harbour, the terminus of large vessels arriving from England, Germany, Belgium, France and, of course, Scandinavia and Estonia. Most of the harbour is, however, used for general goods traffic, principally imports from the Baltic Sea and North Sea ports. At the extremity of this harbour there are smaller quays for the coastwise traffic, etc.

The harbour has at present 1,811 m. of quayage, of which about 250 m. have a depth alongside of 10 m. and 72.328 sq. m. storage in warehouses. The general goods quay is equipped with 11 cranes, whereof four of modern radial type with a 19 m. radius. One of the cranes, the oldest, is stationary, with a lifting capacity of 25 tons.

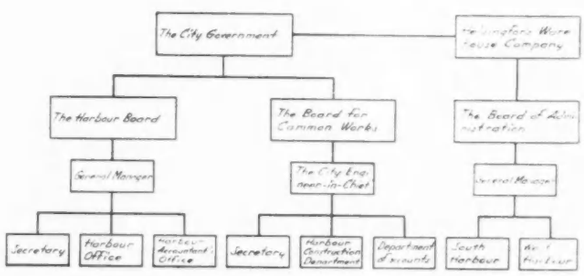
The quays are, as already mentioned, old, and have been partly rebuilt. They are chiefly founded on wooden caissons, which rest on a stone embankment, or on the rock bed. The caissons are filled with concrete and stone. The quay wall is of concrete, and the front is faced with granite. Only about 150 m. quay, which was built 1933-34, is of modern construction, viz.: a pile foundation, with the front wall of Larssen IV and V steel sheeting. The depth of water here is 10 m.

West Harbour

This harbour section is situated on the west side, and is the largest and most up to date in the city. It is also in the main reserved for general goods from trans-ocean ports. The greatest proportion of imports is handled here. The harbour is equipped with the most modern warehouses, and on the quay side run 12 semi-portal cranes over two railway tracks. The lifting capacity of the cranes is from 1.5 to 5.0 tons, and their radius 13 m. The quay is of relatively recent construction, and therefore in fairly good condition. The quay wall here also is founded on wood caissons resting on a stone embankment or on deep hard gravel strata. The caissons are divided into chambers, of which the front chambers are filled with concrete and the back chambers with stone and sand in the voids. The older caissons are filled only with stone. The water depth varies from 7.2 to 10 m. below the mean water level.



A State Icebreaker forcing a Packice Zone.

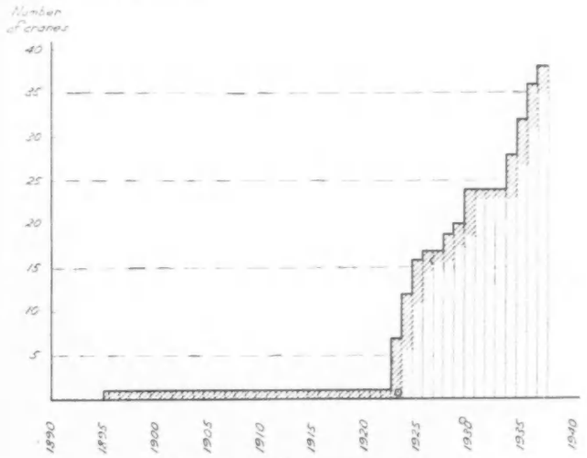


Departments of the Port Authority.

In the west section of the port is the coal harbour of the city. With its good quays and up-to-date crane equipment, it is one of the largest and most modern in the North. At present, there are four gantry cranes, 83.5 m. long and three conveying gantrys 81 m. long. By means of each crane, 90 tons of coal per hour can be transported from the vessels to storage places, which are rented to private firms. The quay is fitted with three railway tracks and seven movable portal cranes with a lifting capacity of 5.2 tons and a radius of 16.5 m. By means of these cranes the coal is handled from the ship directly to railway waggons or cars.

Port of Helsinki (Helsingfors)—continued

The quay, the length of which is 475 m., has a substructure of equal sized wood caissons, as earlier mentioned. The caissons rest on stone embankments or directly on the rock bed. The concrete filling in the caissons has, during the last five years, been made in accordance with the "Contractor" method, i.e., the concrete is fed through steel tubes to its appointed place without coming in contact with the water. In the year 1932, the quay was lengthened by 116 m. on a site where the solid ground lay at considerable depth. The quays here were constructed with foundations of sheet piling, consisting of a front wall of Larssen VI (Resista steel). The piles were driven into a previously deposited sand embankment. Because the main quay structure also was supported on the steel sheeting, the reinforced concrete platform was linked between the timber pile and the steel sheeting system.



Cranes erected from 1895-1937.

The total quay length in the West Harbour is 2,100 m., and the storage area in the warehouses is 37,233 sq. m.

Sörnäs Harbour

Sörnäs Harbour is situated on a peninsula on the east side of the town. It was the first to be fitted with railways, and therefore destined for export traffic. It is still the main export harbour, but is also used for oil imports. The ordinary oil harbour will, however, be moved out to the new Hertonäs unit.

The quay walls are formed as piers founded on timber piles, and are equipped with two or three railway tracks. The quay length is about 1,100 m. and water depth from 3.7 to 5.4 m.

Hertonäs Harbour.

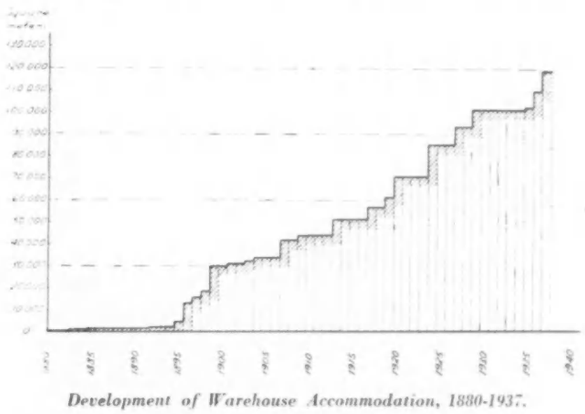
Not until now has Helsingfors had any ordinary industrial harbour, and the present oil harbour is in a dangerous proximity to the wood export harbour. Because of the town's rapid development during the last decade, the plans for a new harbour section for this purpose became pressing, and the position was fixed at Hertonäs, the easternmost limit. The harbour had to be connected with the Government railway system by a new line, which at present is under construction. Furthermore, a timber oil pier is already in use.

Other Harbour Sections, Docks and Repairs

In addition to the above-mentioned harbour sections assigned to ordinary sea traffic, the city has also two smaller ones, the Sea Harbour and the North Harbour, which are used for coastwise traffic and for small craft.

The port provides, moreover, first-class facilities for building, repairing and cleaning vessels of all kinds. In the West Harbour is a dry dock of 108.5 m. in length and 16.3 m. in breadth at the entrance, and 5.5 m. deep over the sill; and a floating dock of 2,750 tons lifting capacity. These two docks belong to a private company.

The Government possesses at Sveaborg, the fortified islands outside the town, a dry dock with two chambers, the inner



Development of Warehouse Accommodation, 1880-1937.

130 m. by 12.5 m., and the outer 115 m. long and 20 m. wide at entrance. The depth over the sill is 4.5 and 6.5 respectively. Furthermore, the Government has in the North Harbour a floating dock of 1,800 tons lifting capacity, and a floating crane with 60 tons lifting capacity.

Enlargement Plans

The plans for the further extension of the Port of Helsingfors will be seen in the Supplement. They are very ambitious, and it will be some considerable time before they can be commenced. At present, the quayage in the existing harbours, excluding Hertonäs, are sufficient; therefore new works of construction during the following years will be limited to improvement of the quay equipment, such as cranes, warehouses and railway conditions for increasing the efficiency of the harbour. The old quays in South Harbour (Myntkajen) are also in a bad condition, by reason of settlements in the stone embankment under the wood caissons, so that during the coming years, important reconstructions will be carried out in this section.

Publications

Port of Leith.

The Leith Chamber of Commerce have published in an enlarged form the fourth issue of their handbook on the Port of Leith. It is an interesting and useful publication of 127 pages, containing full information about the port and its commercial activities. There is an Official Directory containing a list of officials of the Leith Dock Commission and the Leith Chamber of Commerce, together with a chronological table of important historical events associated with the port. Particulars are given of the harbour and dock accommodation and of auxiliary dock services, such as pilotage, ship salvage, towage, etc., and a list of shipping services and sailings from Leith. The brochure contains a number of interesting facts about the trades of the port and their development.

The book has been compiled and arranged by Mr. Arch. Carswell, the Secretary of the Chamber and is published by George C. Mackay, Ltd., 45, Bernard Street, Leith.

Lloyd's Book of Ports and Shipping Places.

In consequence of a number of requests received at Lloyd's for information on the position of ports and shipping places, the Corporation have issued, under the above title, a list, arranged geographically, of ports and shipping places of the world, with an index thereto. The list starts with the South Coast of the British Isles following round in a clockwise direction and then proceeds to the Arctic and Scandinavian ports and other ports of Europe, Africa, Asia and America. In all cases, the latitude and longitude is given. As a means of identifying the location of shipping places, with or without an atlas, the brochure should be very useful. It is not to be expected that all names of places on the coastline of the world are to be found, as such a comprehensive list would be too cumbersome for ordinary use. The list is full enough for all practical purposes.

The Department for Overseas Trade have issued a report on the economic and commercial conditions in Angola (Portuguese West Africa). It is dated February, 1937, and has been prepared by Mr. F. O'Meara, His Majesty's Consul-General, Laonda. It gives an interesting survey of the conditions prevailing in the Portuguese Colony, although its reference to port affairs is limited to a brief statement of the accommodation available for shipping at Loanda, Lobito and Mossamedes, with the addition of a statement of the exports from Lobito during 1935-1936. The report is published by H.M. Stationery Office at the price of 9d.

Lloyd's Register Book for 1937-8, just issued, is the 104th annual issue since the Re-constitution of the Society and contains, as in previous editions, complete particulars of all sea-going merchant vessels of the world of 100 tons and upwards, besides other information of more general interest. One of the statistical tables shows the increase in gross tonnage of steamers and motor ships in the world for 1937 over 1914 is almost 44%, but that Great Britain and Ireland have receded by 7.7 % in their proprietorship.

Operation of Lock Gate Machinery

Interesting Conversion from Hydraulic to Electric Drive at Avonmouth

(CONTRIBUTED)

A SCHEME which it is considered will be of interest to Docks Engineers has recently been carried out by the Port of Bristol Authority, the main Contractors being The East Ferry Road Engineering Works Company, Ltd., of London.

The scheme consisted of the conversion from hydraulic operation to electric drive of six sets of lock gate opening and six sets of lock gate closing machines, together with six sets of sluice operating machines.

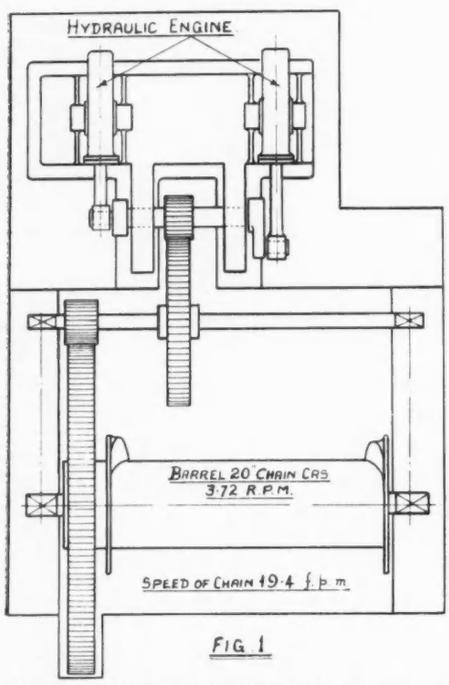


Diagram of Original Hydraulic Lock Gate Operating Machines.

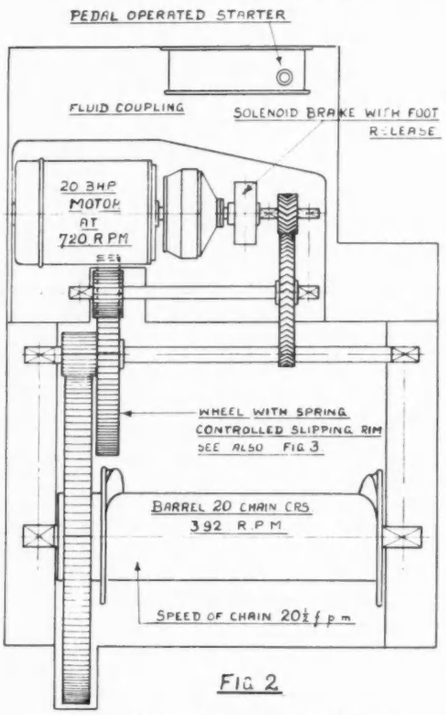

PEDAL OPERATED STARTER
FLUID COUPLING
SOLENOID BRAKE WITH FOOT RELEASE
20 BHP MOTOR AT 720 R.P.M.
WHEEL WITH SPRING CONTROLLED SLIPPING RIM SEE ALSO FIG. 3
BARREL 20 CHAIN CRS
3·92 R.P.M.
SPEED OF CHAIN 20½ f.p.m.
FIG. 2

Diagram of Electrically-operated Lock Gate Operating Machines.

As there is a considerable rise and fall of tide at Avonmouth and the outer locks open to the sea it was at once appreciated that difficulties would arise before electrical operation would satisfy the working conditions in the simple manner of hydraulic operation, the latter method having the great advantage of a steadily maintained stalling torque.

The gates before conversion were opened or closed by separate hydraulic winches, the prime mover being a twin cylinder hydraulic engine of the differential ram type which drove the chain drum through suitable gear reductions to give the required speed of the gate operating chains. The pressure to the engines was supplied by means of a main hydraulic pumping station, accumulators and pipe lines, etc. The accumulator pressure being 750-lbs. per square inch.

A diagrammatic layout of the original hydraulically operated gate machines is shewn in Fig. 1 and in Fig. 2 is shewn a diagrammatic arrangement of the new electrically operated gate machines.

The main difficulty in the electrical conversion was to produce the ideal stalling characteristics possessed by the hydraulic engines. It was calculated that the hydraulic engines would exert a maximum pull in the gate operating chains of eleven tons. In view of the fact that the old original timber gates were to be retained for the present it was very desirable to ensure that the electrical operation should not impose a greater maximum pull than that exerted by the hydraulic engines. The gate chains being of 1¼-in. diam. short link chain having a maximum breaking load of 42 tons, the factor of safety on the maximum chain pull of 11 tons would be 3.8 to one.

The hydraulic engines would perform the following duties, all of which it was very desirable to retain as far as possible in the electrical operation:—

(a) Should the gates be run against the dock wall and inadvertently be maintained in this position with the pressure still on, the pull in the gate operating chain remains steadily stalled at 11 tons, due to the fact that the accumulator pressure is steady at 750-lbs. per square inch and the engines could not, of course, receive higher pressure acting on the rams.

(b) Should wave or heavy wind load, etc., strike the gates during operation and tend to impose a greater pull in the chains than 11 tons, the hydraulic engines would be driven momentarily in a reverse direction and no damage to gate chains or gates would be done.

(c) Carry out the actual mitreing of the gates with ease of control and with predetermined stalling load in the gate chains.

The electrical current available is alternating and it will be seen at once that if an electric motor and spur gear be substituted for the hydraulic engines and gearing to give a working pull of 11 tons in the gate chains at normal rated B.H.P. of the motor and the gates meet with any obstruction or wind and wave action increase the resistance to operation, the motor unless possessing special stalling characteristics would develop a momentary overload and increase the pull in the operating chains which might easily cause damage to them or to the gates themselves (in this case as they are old gates of timber construction). Again, should the gates be run in against the dock wall and the motor left in a stalled condition at overload for any appreciable time, serious damage might easily be done to the motor itself.

Certain electrical systems of control were considered with a view to obtaining ideal stalling characteristics. There were certain drawbacks, the cost was considerable and it was finally decided that a relatively cheap yet effective method of obtaining a stalled condition giving 11 tons steady pull in the chains was to employ a Fluid Flywheel, or more correctly—a Vulcan Sinclair Fluid Coupling (Fig. 3) on the motor extension shaft and to drive through this the necessary spur gear reductions to give the required speed of operation at the gate operating chains. By this system of power transmission, the pull in the

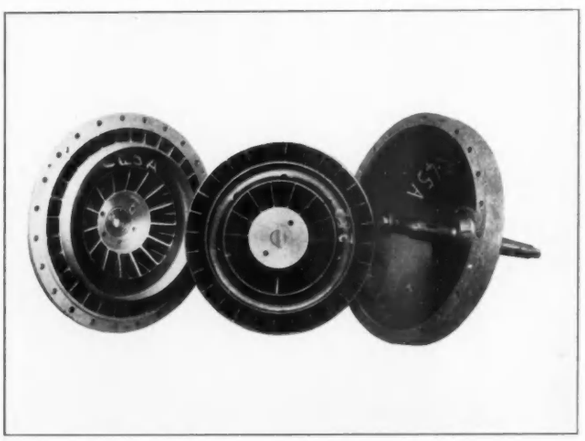
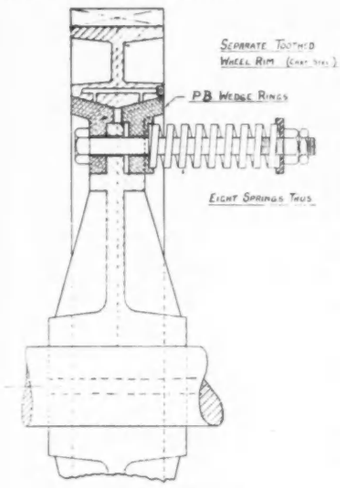


Fig. 3. Type of Fluid Coupling used on Lock Gate Machines.

Operation of Lock Gate Machinery—continued

chains will be imposed even more smoothly than with the original hydraulic engines, and the electrical control is so simplified that straight on the line contactor starting with pedal operation can be employed and the expense of the fluid coupling is more than offset by the saving entailed in dispensing with elaborate electrical control devices.



(FIG 4) DIAGRAM OF SPRING CONTROLLED SLIPPING RIM TO SPUR WHEEL

By means of the fluid coupling, it is possible to arrange that the coupling will transmit only sufficient torque to give 11 tons pull at the chain and to remain stalled at this torque. This limitation in the stalling torque is effected by the use of a "baffle" in the fluid working circuit of the coupling, which "baffle" does not, however, materially affect the slip or normal working loads. The stalling torque can be adjusted over a small range by varying the amount of oil with which the coupling is initially filled. It is considered that this stalling characteristic is ideal for the duties under consideration and especially for actual mitreing of the gates, but as the fluid flywheel will not resist any torque in the reverse direction, should the current to the motor fail, and also will not resist a heavier torque than that from normal setting (in this case 9 to 11 tons chain pull) it will be seen at once that in order for the machine satisfactorily to resist a greater reverse pull than 11 tons in the gate chains from wind or wave action some braking device will have to be introduced and situated on the driving side of the fluid coupling or gear shafts. It was decided to fit a solenoid brake in order to hold the gates against a sustained pull, as this condition is sometimes required, for instance in levelling through the locks from the tide with the gates held slightly open with a higher head on the outside of the gate. On fitting this brake, it was appreciated that a further difficulty had arisen, namely, should wind or wave strike the gates when slightly open and being maintained in this position by means of the solenoid brake, the gears would be locked, and in the event of a much greater pull than 11 tons being imposed on the chains they would be seriously strained, especially after some years service, and reduction in the sectional area of the links has taken place (as is found to be the case in practise).

To guard against the above condition, it was thought advisable to fit a well designed and lubricated metal to metal slipping device which would automatically slip when the torque was greater than that required to give 11 tons pull in the operating chains. This slipping device was incorporated in a gear wheel on the second motion shaft, the toothed rim of this wheel being separate from the centre. Detail of this slipping device is given in Fig. 4, as it has been found to act very satisfactorily. From the detail given it will at once be appreciated that it is easily adjusted to any degree of torque transmission up to the full strength of the gear teeth at the slipping rim.

A Ferodo lined slipping device was not considered because of the damp and varied atmosphere of the pits housing the machines, it being thought that well lubricated metal to metal surfaces would maintain a more constant coefficient of friction.

It should be appreciated that this device will only be called upon to function at very infrequent intervals and then only for a very short period of time and purely as an emergency condition.

Calculations for pull required in Lock-Gate opening and closing Machines, and B.H.P. of Motors for operating the new Electric Winches

The actual power required to operate the lock gates is not easily determined, since so many factors enter into this question.

(1) Speed of operation.
(2. Type and condition of the old roller paths.
(3) Suction, or perhaps it would be better to say "Stiction" of the gates when closed against the dock walls.
(4) Eddy action during movement.

It was decided to calculate the water horsepower of the existing hydraulic engines operating the gates at 750-lbs. per square inch accumulator pressure; also to observe the average speed of the operating chain in feet per minute off the barrel and to take an estimated chain pull. The product of these two giving work done at the barrel, and allowing for the overall efficiency of the winch gear and engine efficiency this can be converted to B.H.P. at the engines and should check with the B.H.P. of the hydraulic engines as found from bore stroke and R.P.M., etc.

The speed of operation of the gate chains by the original hydraulic engines was observed to be 19.4 feet per minute.

The estimated pull to operate the gate was calculated from manual effort of the auxiliary hand gear with which all the gate operating winches were originally fitted.

Taking 30 pounds per man at the hand gear capstan bars (an average design figure) as the maintained average pressure and allowing appropriate gearing efficiency the pull in the operating chains was found to be $6\frac{3}{4}$ tons. Assuming this to be normal effort at the gate operating chains with the gates on the move and further that to start the gates when they were close against the dock wall, each man would have to exert 50-lbs. effort on the capstan bars giving proportionately

$$6.75 \times \frac{50}{30} = 11.2 \text{ tons maximum chain pull required to operate}$$

the gates.

Assume from the above that 11.2 tons pull is the maximum chain pull required.

$$\text{Now 1 B.H.P.} = \frac{33{,}000\text{-ft. lbs.}}{2{,}240} = 14.7 \text{ foot tons per minute.}$$

Speed of operation required at chain = 19.4-ft. per minute.

Therefore foot tons per minute required at chain = 19.4 x 11.2 = 218 foot tons per minute.

$$\text{And actual B.H.P. required at chains} = \frac{218}{14.7} = 14.8 \text{ B.H.P.}$$

The original hydraulic machines had two cast gear reductions assumed with their bearings at 90 per cent. efficiency each.

Therefore gear efficiency = 81 per cent.

Hydraulic engine efficiency say 90 per cent.

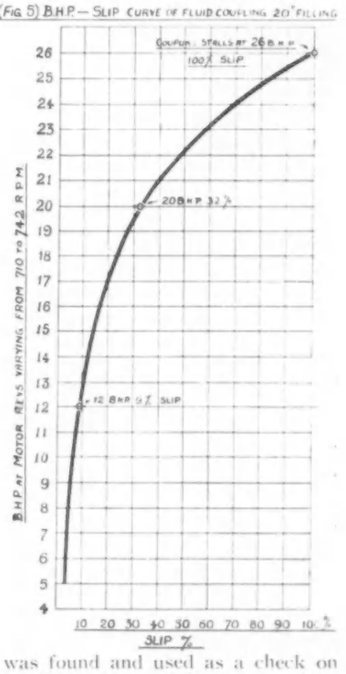
The overall efficiency of the original hydraulic operating winches would be .81 x .9 = say 73 per cent. and the B.H.P.

$$\text{required at the original hydraulic engines} \frac{14.8 \text{ B.H.P.}}{.73} = 26.3 \text{ B.H.P.}$$

The actual B.H.P. of the engines from bore, stroke pressure and R.P.M., etc., was calculated to be 20 B.H.P., checking very accurately with the assumptions taken previously.

It was, therefore, taken that the B.H.P. required by the electric motor on the new design of electric winches would be 20 B.H.P., giving approximately 11 tons pull at 19.4 feet per minute during the first few feet travel of the gate; it was also considered that the average B.H.P. required throughout the operation would be in the region of 12.25 B.H.P., corresponding to a chain pull of $6\frac{3}{4}$ tons and the assumption was borne out by the horsepower calculated from electrical readings taken at actual test after installation.

(FIG 5) B.H.P.—SLIP CURVE OF FLUID COUPLING 20" FILLING



The only formula which was found and used as a check on the calculations was one by Professor Henry Adams, an authority on Hydraulic Machinery, at the time the old machines were constructed and given in his "Facts and Formulae," and stated thus:—

P = Pull required in operating chain in tons.
W = Width of lock in feet.

$$\text{then } P = \frac{W \times 375}{2{,}240}$$

Width of lock under consideration in this case was 70 feet.

$$\text{Therefore pull in tons} = \frac{70 \times 375}{2{,}240} = 11.7 \text{ tons.}$$

After all calculations and assumptions had been made and as a final check the actual chain pull exerted by the old hyd-

Operation of Lock Gate Machinery—continued

raulic engines at the drum was taken by means of a Duckham balance and suitable pulley lead, and found to be:—

One engine crank on dead centre 8 tons pull.

Two cranks in operation 10 to 12 tons.

The assumptions made were thought to be conclusive and as stated were borne out in actual practice as the electrical readings of the new design in operation closely agreed with the estimated power required.

Characteristics of Fluid Coupling and Speed of Operation of Lock-Gate Machines

The point to remember is that a fluid coupling does not in any way modify torque, the input and output torque are always equal and the loss of horsepower directly proportional to the percentage of slip between the input and output shafts which is dissipated in fluid friction and heat.

On the test bench at works this particular fluid coupling when filled to what is known as 20% filling stalled at 190 foot pounds torque calculated by means of dynamometer, the current reading between 42 amperes corresponding to 26 B.H.P. at the motor, the latter running at 720 R.P.M.

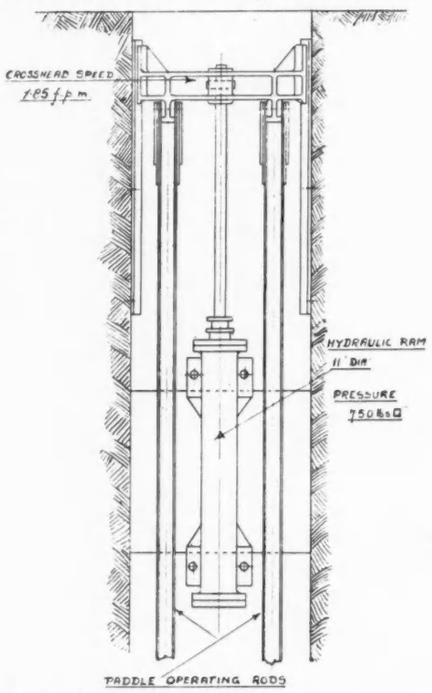


Fig. 7.—Original Hydraulic Sluice Operating Gear.

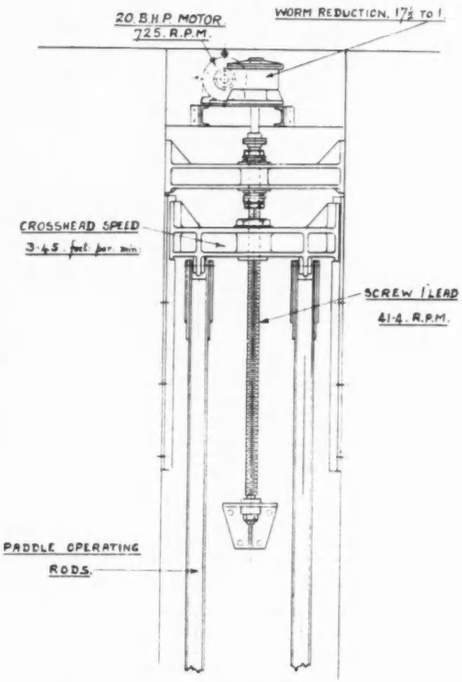


Fig. 6.—Electrical Sluice Operating Gear.

The radius of the motor shaft pinion pitch circle being 2½-in. or .208 feet.

Therefore the maximum possible load at the pinion pitch circle would be $\frac{190}{.208 \times 2{,}240} = .407$ tons, and allowing for the mechanical advantage and efficiency of the gear reductions the maximum pull at the operating chain with 26 B.H.P. at the motor would be 13.6 tons. The coupling is, therefore, well up to its specified duty of 20 B.H.P. at 720 R.P.M. corresponding to a chain pull of approximately 10½ tons.

Speed of Operation of Lock Gates

To ascertain the actual speed of operation of the gates it will be necessary to examine the B.H.P.—slip curve of this particular model of coupling shewn in Fig. 5.

Assuming the average B.H.P. at the motor through range of operation of gates to be 12 B.H.P. the percentage of slip given by curve is 9 per cent. Speed of motor at normal rated capacity of 20 B.H.P. is 720 R.P.M. The makers guaranteed speed of motor at 12 B.H.P. is 731 R.P.M. Taking 9 per cent. slip on the fluid coupling the output shaft would be running at 731—65.8 R.P.M., that is 665.2 R.P.M.

Fluid coupling output shaft therefore runs at an average speed of 665.2 R.P.M. and allowing for the gear reductions fitted to the winches the revolutions per minute at the chain drum 3.92 R.P.M.

The barrel chain centres being 20-in., the speed of the operating chain would be $3.14 \times \frac{20}{12} \times 3.92 = 20.5$-ft. per minute.

Chain speed of electrical operation 20.5-ft. per minute; for operation of the gate 31 feet of chain has to be wound on the chain drum (after taking in slack chain).

Therefore time for operation of gate $\frac{31}{20.5} = 1.51$ minutes; the specified time being 1.5 minutes.

The actual observed time of operation on test was 1 minute 53 seconds.

At the actual test after installation it was found that the maximum current taken was 20 amperes corresponding to 18.5 B.H.P. at motor and an operating chain pull of 9.375 tons; the B.H.P. of motor fitted being 20 B.H.P.

Summary of Electrically-operated Lock-Gate Winches

Width across lock, 70-ft.

Specified time for operation, 1.5 minutes.

Actual time for operation on test, 1.51 minutes.

B.H.P. of motor 20 B.H.P. at 720 R.P.M. (3 phase 365 volt supply).

Maximum B.H.P. taken = 18½ B.H.P.

Pull in lock gate chains at 18½ B.H.P. = 9.375 tons.

Control: Direct on line Contactor Starter Pedal operated.

Gearing: All steel gear designed to Lewis Formula .6 shock factor.

Main Contractors: The East Ferry Road Engineering Works, Co., Ltd.

Hydraulic Coupling by The Hydraulic Coupling and Engineering Co., Ltd., Isleworth.

Motors by Messrs. Laurence Scott, Ltd.

Control Gear: The Igranic Electric Co., Ltd.

Conversion of Sluice-operating Machines

There were six sluice machines to be converted from hydraulic to electrical operation.

Fig. 6 shews the general layout of the original hydraulic sluice gear.

Fig. 7 shews the substituted electrical sluice operating gear.

Calculation for Sluice Conversion

The original sluice paddles were lifted by means of spear rods and a cast iron cross head connected to the piston rod of an hydraulic cylinder as shewn in Fig. 6; the diameter of the piston for this duty being 11-in. and having an effective area of 95 square inches which at 750 pounds pressure per square inch would be capable of its maximum lifting effort of $\frac{95 \times 750 \times .9}{2{,}240} = 28.5$ tons.

Note.—.9 in the above is the efficiency of the hydraulic ram due to gland packing friction.

28.5 tons is, therefore, the maximum lifting effort the original sluice operating machines would exert.

The lifting speed of the original machines being 6 feet in 3¼ minutes or 1.85 feet per minute.

Note.—For the new design of sluice operation by electrical power it was decided to increase the speed of operation to 6 feet in approximately 1¾ minutes or 3.43 feet per minute.

Calculation of Power required to Lift Sluice at this speed

The maximum pressure on the sluice paddle occurs during scouring duties, i.e., when the maximum head of 37 feet equivalent to 16-lbs. per square inch pressure is at the back of paddle with no relief pressure on the front of it.

The size of paddle being 8-ft. 6-in. deep by 6-ft. wide (the sluice aperture being 7-ft. by 4-ft. 6-in.).

The pressure on the back of the paddle with no relief pressure on front would be $\frac{102\text{-in.} \times 72\text{-in.} \times 16}{2{,}240} = 52.5$ tons.

The paddles are of timber sliding on timber frames and taking a coefficient of $\phi = .4$.

The pull required to overcome the resistance to sliding friction due to back water pressure would be $52.5 \times .4 = 21$ tons.

Operation of Lock Gate Machinery—continued

In addition, the pull to lift weight of cross head spear rods and paddle would have to be added, the weight of these items being 4 tons.

The maximum lifting power to be given by the sluice screw on the new design was fixed as 21 tons plus 4 tons = 25 tons.

Therefore, the basis of design for the electrical sluice operating machinery is that the operating screw is to give a pull of 25 tons at 3.43 feet per minute corresponding to 6 feet operation of sluice paddle in 1¾ minutes, a considerable increase in speed over the old hydraulic sluice gear.

Note.—For normal locking duties the pull required by screw equals 15 tons. This is due to the fact that during locking duties there would be water on both sides of the sluice paddle at different heads of course, but giving relief pressure on paddle.

The new sluice gear is operated by means of a 20 B.H.P. motor running at 725 R.P.M. and the crosshead operating the sluice rods is driven by means of a worm gear reduction and a single thread operating screw, and from particulars of these we will ascertain the B.H.P. required at the motor to operate the paddle at the specified speed of 6 feet in 1¾ minutes.

Particulars of Worm Reduction

Worm 1½-in. pitch double thread 5.289-in. pitch diameter; Material: steel case hardened and ground.

Worm wheel 25 teeth 16.711-in. pitch diameter; 4¼ width of face; material: Phosphor Bronze; tooth rim: cast iron centre.

Reduction ratio 17½ to one.

Guaranteed efficiency of worm gear, 87 per cent.

Particulars of Operating Screw

Stainless steel screw and phosphor bronze nut fitted with ball bearing thrust races, ½-in. square thread, single thread, 4-in. pitch diameter, lead 1-in.

The coefficient of friction for screw and nut, assuming hand greased condition, has been taken as .125, giving an efficiency with ball thrust races of 35 per cent.

The combined efficiency for worm gear reduction and screw and nut will, therefore, be .87 x .35 = 30.4 per cent.

B.H.P. required at Motor for Specified Duty

Motor speed = 725 R.P.M.

Worm reduction = 17½ to one.

Therefore R.P.M. of operating screw = $\frac{725}{17.5}$ = 41.4 R.P.M.

Lead of Screw = 1-in.

Therefore travel of crosshead and paddle per minute = 41.4 inches, or 3.43 feet per minute.

Maximum pull required at screw = 25 tons.

Therefore, foot tons per minute required at screw = 3.43 x 25 = 85.7 foot tons per minute at operating screw.

Now 1 B.H.P. is equivalent to 14.7-ft. tons per minute,

therefore B.H.P. required at screw = $\frac{85.7}{14.7}$ = 5.83 B.H.P.

Combined efficiency of worm gear and screw = 30.4 per cent.,

therefore B.H.P. required at motor = $\frac{5.83}{.304}$ = 19.15 B.H.P.

B.H.P. of motor actually fitted = 20 B.H.P.

Time to operate sluice paddle through 6 feet travel

$= \frac{6 \text{ feet}}{3.43 \text{ f.p.m.}}$ = 1.75 minutes as specified.

Summary of Sluice Machines

Maximum pull on paddle = 25 tons.

Speed of operation = 3.43 feet per minute.

Each sluice machine is fitted with limit switch gear operated by suitable lever gear attached to the cast steel crosshead.

A slipping clutch of simple design is incorporated in the motor to wormbox coupling.

The machines are operated by direct on the line pedal starters, one for upward movement and one for downward movement of the paddles.

"Custom of the Port"

The following extract is taken from the Annual Report for 1936-37 of the Baltic and International Maritime Conference, which appears in their Monthly Circular for June, 1937.

Latvia

On information being received that the Latvian customs of the port would be revised, a statement containing all the objections raised to these customs was compiled and submitted to the Latvian Chamber of Industry and Commerce. The Chamber gave the assurance that the views of the Conference would be considered. In one respect this was done in the course of the year, namely, as regards the question of a fixed price for the discharge of coal. In previous years it was not possible to enforce the principle otherwise recognised in most countries, that a fixed price shall cover everything for which it is agreed. In Latvian ports, it was held by the Exchange Committees that, for instance, stages could not be said to be part of the stevedoring cost, and should therefore be paid by the vessel in addition to the fixed price. This attitude was upheld, in spite of the fact that the charter-party provided for consignees to discharge the cargo, and consequently to take over the owner's responsibility for the discharge. If, as was actually the case, this responsibility included the payment for and providing of stages, it would seem reasonable to conclude that consignees should take over this cost.

On considering the matter, the Latvian Chamber of Industry and Commerce agreed with the arguments advanced by the Conference, and established the custom that, both for loading and discharge, a fixed price should be considered to cover all the cost arising, i.e., labour insurance, hiring, erecting, and taking down stages.

Antwerp

The customs of the port at Antwerp were included among the subjects discussed by our Executive Committee at its Meeting in January. This discussion referred in particular to the daily quantities for loading grain and for discharging wood cargoes. In both cases the quantities agreed between the Chamber of Commerce and the Fédération Maritime d'Anvers must be said to be prejudicial to owners' interests and incompatible with the despatch expected at a modern port like Antwerp. Owing to the uncertainty of the effect of the labour situation and working conditions on the despatch, further consideration of the question was postponed until the necessary experience was gained.

It was suggested at the same time that the Chamber of Commerce and the Fédération Maritime d'Anvers should agree that a fixed price was to be understood in the same manner as in other countries, that is to say, to include all cost, also extras for handling of cargo in bunkers, poop, and peak. Judgment has been given in Belgium to the contrary, but it was considered to be in the interests of all parties to avoid disputes of this nature by upholding the same rule as applied in other countries. This could best be done by these Institutions lending their influence and authority as suggested.

Finland

As a rule, customs of the port, whether printed or not, are invoked against owners. In Finland the situation arose that a custom of the port of many years' standing was invoked by the Conference in owners' favour. The charter-parties used for the transport of wood cargoes of all kinds do not contain any stipulation concerning notice of readiness to load to be given on arrival of the vessel. For as many years back as recorded in the Conference Office, it has been the custom that loading should commence as soon after the arrival as practically possible. Owners have to give seven days' notice of the probable date of the vessel's arrival. The presumption is that shippers shall act on this advice and have the cargo ready when the vessel arrives. If the loading cannot commence immediately on arrival (provided the vessel arrives within the ordinary working hours of the port), it should be sufficient to allow shippers time to make their preparations until the commencement of the first working period. When owners' own agents and stevedores are employed, there is no difficulty about beginning the work on board at once. It was held by the Conference that, although the charter-party was in fact silent in this respect, the customary procedure was well established, and there was no need to fall back either on the printed customs of the port (which are not recognised by the courts, and which provide for varying periods of up to 24 hours for supplying cargo), or on the Finnish Maritime Law, according to which the lay days shall commence the day following that on which the vessel arrives.

The disputes partly concerned demurrage and partly the calculation of despatch money. In a few cases despatch money was agreed, coupled with a fixed daily quantity, but only for the loading of other wood goods than sawn wood. The point was whether time used before the commencement of the lay days according to the printed customs of the port, respectively as provided in the Maritime Law, should count as lay time. Legal views in other countries differ somewhat in that respect, but on the basis of the long-established custom in Finland owners' claims were successfully settled.

The Dredger "Chien She"

Description of a Powerful New Dredger built to the order of the Whangpoo Conservancy Board

By HERBERT CHATLEY, D.Sc., M.Inst.C.E., Engineer-in-Chief

(ABRIDGED)

Foreword

The following report provides a brief statement as to the factors which controlled the design of the dredger "Chien She," followed by a detailed description of the vessel itself.

The latter part of the report was drafted by Mr. William Smith, M. Inst. N.A., Dredging Engineer, who also supervised the vessel during construction.

At the same time, I wish to record my indebtedness to the late Mr. J. G. Irvine, Mr. W. Smith, Mr. P. N. Fawcett, M. Inst. C.E., and Mr. J. Kolkmann (Technical Director to F. Schichau, G.m.b.H.) in various matters affecting the design of the ship.

During the first year, the vessel was operated by Capt. J. Johannsen and Engineer H. Arndt, whose experience in drag dredging was of great value.

The Dredging Problem

Dredging Equipment

IT was the object of the project to dredge a channel at least 600-ft. bottom width, with a maximum depth of 9-ft. below the crest level, over a length which might amount to 25 sea miles. The minimum depth of water in the channel at extraordinary spring tide was about 17-ft. and the maximum tidal rise above L.W.L. about 16-ft., the mean water level having a rise above L.W.L. of about 8-ft. Tidal currents up to 6 knots, inclined as much as 45° to the axis of the cut, were known to occur, and the water was charged with fine silt up to as much as 2,000 parts by weight per million. The bottom was, as far as could be ascertained, a firmish clay-mud with a density of 1.8, a porosity of about 50 per cent., and a shearing resistance of about 300 lbs. per sq. ft. (1½ tons per sq. metre). Some patches of fine sand, density about 1.9, with a shearing resistance of about 600 lbs. per sq. ft. (3 tons per sq. metre) were later discovered. The underwater slopes were very small, generally less than one per cent. Micro-photographs figures A and B illustrate the appearance of an average sample of Yangtsze mud and sand respectively.

The route to be chosen was that of the thalweg, valleyline, or line of greatest depth and allowing for, say, 50 per cent. re-accretion, it was considered that two drag dredgers, each with an effective annual output of 5,000,000 cubic yards (say 4,000,000 cubic metres) would be adequate.

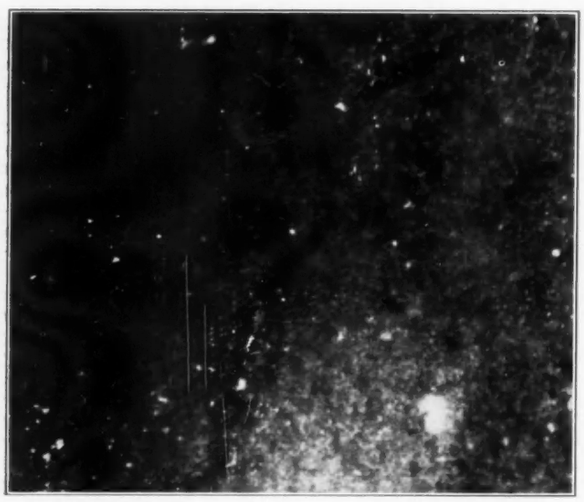


Fig. A—Micro-Photograph of Mud from Yangtsze Bar x 100.

In view of the small slopes, fine material, strong currents, marine conditions and large silt charge, it was concluded that any attempt to dredge with moored dredgers would be futile, so that the trailing type was the only one feasible. The Committee of Consulting Engineers, Shanghai Harbour Investigation, 1921 (Messrs. Black, de Vries, Hiroi, Hornell, Palmer, Perrier and von Heidenstam) had stated that there was reasonable hope of success.

A deepish pool, suitable for dumping, exists within two sea miles of the crest of the bar. Night working was not contemplated, at any rate in the first instance, and weather conditions indicated that at least 10 per cent. of time might be lost by fog and heavy seas. Allowing further for coaling, repairs and annual overhaul, it was assumed that the working hours per annum might not exceed 2,000, implying a rate of 2,500 cubic yards (say 2,000 cubic metres) dredged, transported and dumped per hour. The transportation and dumping were assumed to occupy half the time; considerations of length, beam and draft, limited the hopper load to about 4,000 tons of mixture. Allowing five minutes for approaching the cut and lowering and raising the suction pipe on completion, this implied a dredging rate of 100 cubic yards (77 cubic metres) per minute, or 1.67 cubic yards (1.3 cubic metres) per second.

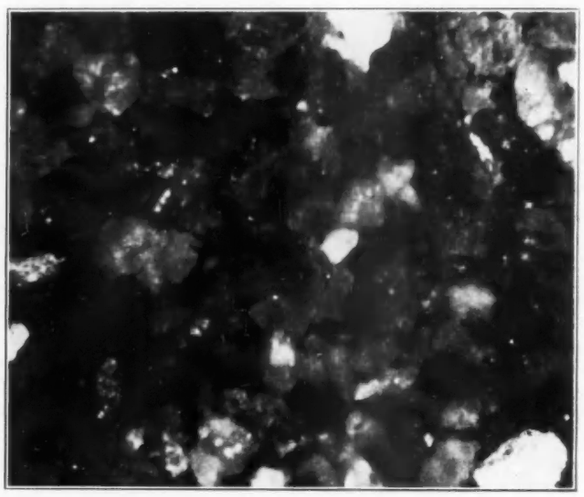


Fig. B—Micro-Photograph of Sand from Yangtsze Bar x 100.

Allowing a speed along the cut of 2 knots (3.4-ft. per second or, say, 1.03 metres per second), the mouth of the drag head needed to be more than 14 sq. ft. (say 1.25 sq. metres). As a certain amount of dilution water would be needed (apart from the high pressure water which enters by jets in the head) and also the head was to be at times oblique to the axis of the cut (on account of the oblique tidal currents), it was decided to specify a width of 9-ft. and a depth of 2-ft., i.e., an area of 18 sq. ft. The study of the mud had shown it to be reducible to a very fluid state with the addition of 50 per cent. of water, giving a density of $(0.6 \times 1.8) + (0.3 \times 1.0) = 1.53$. Even with 25 per cent. of added water—density $(0.80 \times 1.8) + (0.20) = 1.64$—the mixture was quite mobile. Since the added water can enter faster than the mud, the areas provided appeared, and actually later proved, to be adequate.

With such a thick mixture, a fraction of the vacuum is used in supporting the load in the pipe, leaving a smaller amount to overcome friction. Thus if the eye of the pump is at water level (actually in the light draught position, it is about 2-ft. below water level), the lifting head required to raise material with a density of 1.6 is $(1.6—1)\ 45 = 27$-ft., or nearly 25 ins. of mercury. When the draghead is only 30-ft. below water level, the lifting head is diminished to 18-ft. or 16½ ins. of mercury. (If the eye of the pump is 10-ft. below water level, and the draghead 30-ft. below water level, only 2-ft. of lifting head is required). With such a limited margin, every effort must be made to reduce the resistance on the suction side. The builders were therefore required to stream-line the interior of the head, to make the high-pressure water nozzles flush and directed in the direction of flow, a single suction pipe 1.1. m. diameter was insisted on, and the direct arrangement of the pipe from the head to the eye of a single central low-placed pump was considered essential. In order to avoid variations in the cutting angle and the deflection angle at the back of the head, the pressure water pipe was made into a linkwork which maintains the head in a constant "attitude." A very liberal supply of high-pressure water (11 tons per min. at 75 lbs. per sq. in.

The Dredger "Chien She"—continued

pressure, or 27 tons per minute at 14 lbs. per sq. inch) was allowed.

As a result of all these precautions, it proved easy to obtain a mud mixture with a density of well over 1.6 from a depth of about 30-ft., and whole hopper loads with over 1.5 were frequently obtained. Apart from the design, this must be mainly attributed to the smoothness of the mud and the stability of the mixture once it has been churned up. Later, with fine sand about 20 per cent. of sand by volume (mixture density 1.18) was about the best result obtained, as against 66-80 per cent. with good mud.

Fig C—Micro-Photograph of Mud from Pillau Harbour x 100.

The velocities in the suction pipe vary from about 5-ft. per second (say 1½ metres) for thick mud mixture to perhaps twice that value for sandy mixtures.

Still another important aspect of the design is the provision of ample thrust for cutting the bottom with the drag head. Assuming the depth of the cut is 2-ft. and effective width 10-ft. and that the mud ruptures along a plane inclined 1 in 3, the rupture area is 60 sq. ft., which at 300 lbs. per sq. ft. of shearing resistance = 18,000 lbs. or, say, 8 tons. If this force is exerted at a speed of 3.4-ft. per second, the horse power required is $\frac{18{,}000 \times 3.4}{550} = 111$ H.P.

As it often happens that the adverse current is up to 6 knots (making a total relative water speed of 8 knots) the propelling capacity needs to be ample to cope with the combined ship and drag head resistance. 3,000 h.p. at 132 r.p.m. is available from the two propelling engines, and the propellers have the following characteristics:—

11′3 $\frac{3}{16}$″ Dia.
10′9 $\frac{13}{16}$″ pitch
44.35 sq. ft. area (projected).

The propellers usually run at about 120 r.p.m. when dredging, so that the ejection speed is about 21.5-ft. per second. If the relative speed is 10-ft. per second (6 knots) the impelled speed is 11.5-ft. per second, giving a thrust of about 20 tons, leaving, say, 12 tons to overcome the ship resistance, which is ample at that speed.

The position of the suction pipe plays an important part in the design of the ship. In the original Frühling design and all the older models the stern of the ship is split and the suction pipe trails below or behind the rudder. This allows much better arrangement of the machinery and hopper and easier handling of the drag head, and avoids any danger of the head fouling the well, but it makes the vessel very difficult to steer, especially in cross currents, and, if there is any pitching, causes the head alternately to rise in the cut and to bump. The experience in the Argentine is stated to be decidedly in favour of the centre well, and this arrangement was adopted, with entirely satisfactory results. It has a further advantage that by means of a strong framework attached to the suction pipe ladder, the latter can be arranged to bear against the side of the well, thereby relieving the pipe trunnion of considerable strain.

A very sensitive universal control of the pipe hoisting winch in conjunction with vacuum gauge from the main pump enables the dredging to be carried on steadily and efficiently. One bad feature is that the easing up of the pipe causes the cutting to be least on the hardest places.

Density of Dredged Mixtures

In drag suction hopper dredging it should obviously be the aim to produce the densest possible mixture which can be pumped Even if the power required during pumping is in excess of the optimum value for that process per sê the decrease of the cruising and dumping period will generally neutralise any loss of energy due to this cause.

In the writer's paper "Energy Considerations in Dredging," published by the Inst.C.E. in 1932 (Selected Eng. Papers No. 125), p. 9, it was indicated that in ordinary pipe-line dredging a dilution between 3 and 5 volumes (in relation to the situ volume of the dredged material) gave optimum conditions for a long (1,000-ft.) pipe, but that in drag suction dredging (p. 15) as little as ½ volume might be sufficient if the mud were smooth.

Practical experience with the dredger "Chien She" on the Yangtsze Bar has since shown that for certain conditions the mud might be pumped with almost no added water at all.

The specific gravity of the in sitû material is not of itself the sole criterion to be considered. The grain size is also not the decisive factor, although it is probable that fine grained materials tend to be smoother, and therefore will pump more easily than coarse ones. It is obvious that if the proportion of water-filled voids ("Porosity") is the same for materials with different sized grains of a given material, the density of mixture will be the same. In practice, great variations of the in sitû density occur with little or no change in the mineral grain density, indicating clearly that the porosity varies largely. If the "pore-coefficient" (ratio of pore space to grain volume) is used, the differences are still more remarkable. Thus the mud in the Koeningsberg ship canal at Pillau (E. Prussia), where the "Chien She" had builder's trials, had a density of only 1.25, while on the Yangtsze the density was in places over 1.80. In both cases pumping was possible with about 50 per cent. added volume of water, giving densities of 1.17 and 1.53 respectively. Taking the density of the mineral in each case as 2.6, the porosity of the German mud was 0.843 and its pore coefficient 5.4; the Chinese mud had values of 0.50 and 1.0 respectively. The pumped mixtures had values of 0.894 and 8.4 for the German mud and 0.66 and 2.00 for the Chinese mud. Such a difference is only explicable on the basis of a spicular or honeycomb structure in the German material which could remain firm and yet contain a large amount of interior space. Packed dry snow shows a similar anomalously low density due to its spicular structure.* The Chinese mud, on the other hand, consists of compact or flaky particles which fit well together and only need slight separation to make them free.

All these characteristics have been explained by Prof. Terzaghi in his well-known works on Soil Mechanics.

Micro-photographs of the Pillau mud and sand samples are shown in Figs. C. and D. respectively.

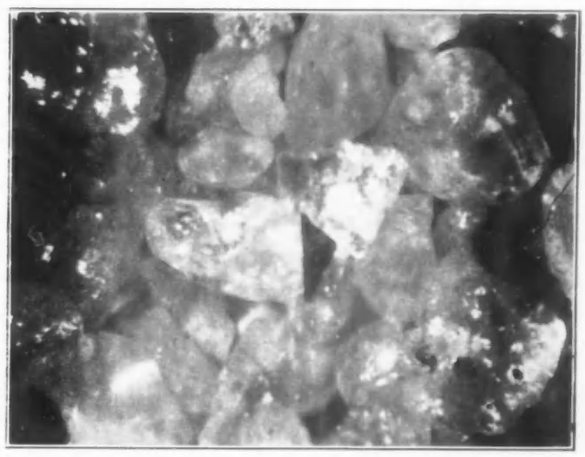


Fig. D—Micro-Photograph of Sand from Pillau Harbour x 100.

Dredging Sand

There appears to be considerable doubt as to how far the Frühling principle can be applied to the dredging of sand. Experience, both in the Yangtsze and elsewhere, clearly shows that with the ordinary mud head the efficiency falls off greatly when dredging sand. This may be attributed to the following causes:—

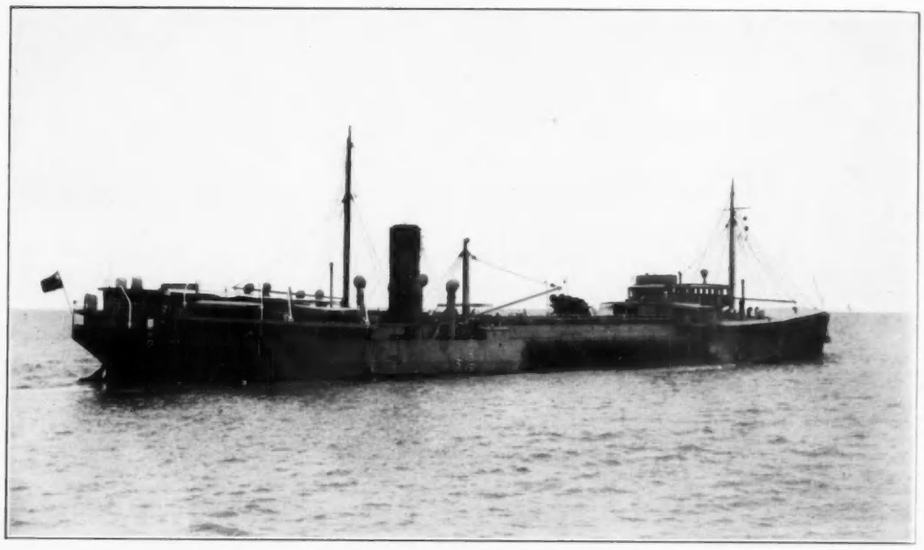
(a) Shallower penetration of the cutting edge into the bed on account of increased resistance, allowing much more dilution water to enter the upper part of the opening.

* (Loose dry snow has a density of 0.0833. Since ice has a density of 0.926, and the spaces in the snow are filled with air of practically no weight, the porosity is .91 and the pore coefficient 10! By pressure snow may be consolidated, but unless the pressure is sufficient to cause local melting and freezing solid, the porosity remains quite large).

The Dredger "Chien She"—continued

(b) Rapid settlement of the sand in the mixture causing the average density of the mixture to be lower than required by minimum dilution.

From experience with the "Leviathan" and other sand pumps, it is clear that in certain circumstances mixtures containing as much as 45 per cent. by bulk volume of sand (density of mixture, say, 1.4) may be pumpable, and the practical problem is how such a density may be produced and maintained. Many designs have been studied, including disc ploughs, jet intake of suction water, relief valves for suction water, spade-pointed and parrot-beaked cutting edges, shoe-shaped drags with cutting grills, oscillating heads, etc., but in many cases these are speculative designs. Some builders hold that the mud form is also the most suitable type for sand dredging, especially if a smaller entrance area is provided. Experience in the Yangtsze appears to show that reduction of the entrance area by plates which divert the dilution water down on to the entering sand helps. Since the head cannot be buried in the sand as it may be in the mud, because of the extra dilution water wanted and the increased resistance, this appears a logical method. Strengthening the pipe and adding to the propeller thrust is also indicated.



The Dredger "Chien She" at Yangtsze Bar.

Certain mechanical conditions apply to the cutting of sand which reduce the efficiency of a head designed for mud. The greater resistance of the sand to cutting causes the depth of the cut to be less, exposing the upper part of the opening to the relatively free inflow of the water. The velocity of inflow of the water is determined by the residue of the vacuum which remains after deducting:—(a) The head required to support the excess of the mixture density above unity, and (b) the friction in the pipe. With thin mixtures (a) is small (e.g., if the density is 1.20 and the lift is 40-ft., the head required is 8-ft.; if the density is only 1.10 the head required is only 4-ft.). As to (b) the friction on the pipe is small, except for high densities or very high velocities. If the velocity is 20-ft. per second, the resistance per sq. ft. is about 2 lbs., or about 2,000 lbs. for the whole suction pipe, or 160 lbs. per sq. ft. of section, or, say, 1 lb. per sq. inch, 1/15 atmosphere, or say, 2-ft. head. (For clean water).

Hence if the vacuum at the eye of the pump is 26-ft. of water (say 24 inches of mercury), there may easily remain 9-ft. of vacuum at the mouth which will produce a water influx velocity of $\sqrt{64 \times 9} = 24$-ft. per second. If the water area is half the opening and the sand is being cut at a speed over the bottom of 3-ft. per second, the ratio of water to sand is as 24

or 8 times as much, giving a mixture with a density of about

$$\frac{(1 \times 2.0) + (8 \times 1)}{9} = \frac{10}{9} = 1.11$$

If the water intake area can be halved ($=\frac{1}{4}$ the whole area) by a flap, the ratio is as 12/3, or only 4 times, giving a mixture density of

$$\frac{(1 \times 2.0) + (4 \times 1.0)}{5} = \frac{6}{5} = 1.20$$

If the water intake area were quartered ($=\frac{1}{8}$ the whole area), the ratio would be as 6/3 or 2 times, giving a mixture density of

$$\frac{(1 \times 2.0) + (2 \times 1.0)}{3} = \frac{4}{3} = 1.33$$

This is probably the limit, as the head required to lift the mixture now begins to grow appreciably.

This cutting down of the water area will not increase the quantity dredged, which depends wholly on the depth of the cut, but it will increase the density of the mixture, so prolonging the dredging time required to fill the hopper and reducing the proportion of dumping time.

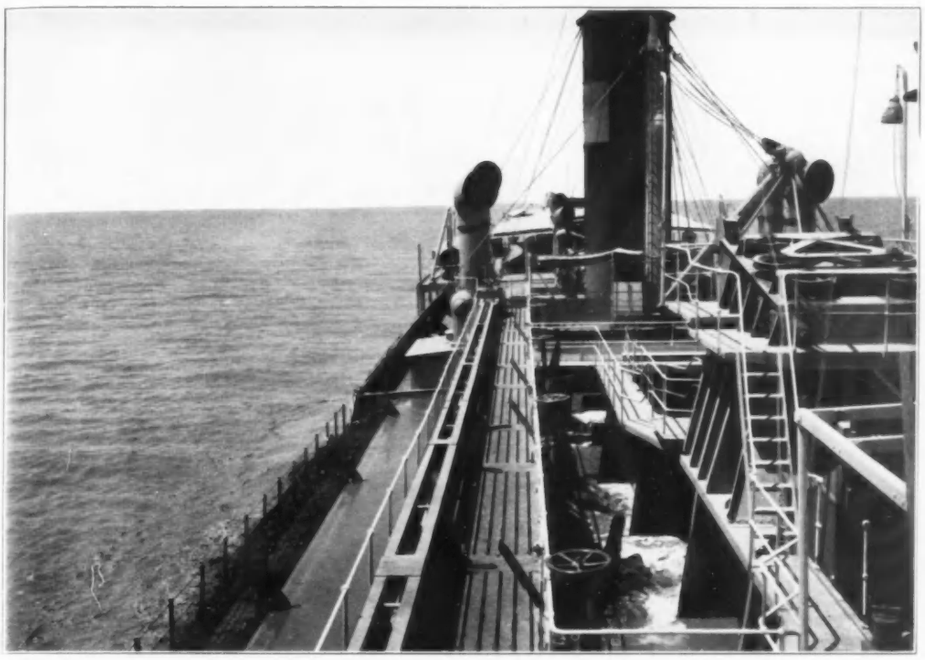
General View of Dredger looking Forward.

Description of the Dredger "Chien She"

On the 9th February, 1935, there sailed from Danzig the new twin-screw steam drag suction dredger "Chien She," built to the order of the Whangpoo Conservancy Board, Shanghai, by F. Schichau, G.m.b.H., at their Danzig yard; the machinery and dredging equipment having been constructed at their works in Elbing, Germany.

The voyage to Shanghai, conducted under the most economical steaming conditions, to obviate re-bunk-

The Dredger "Chien She"—continued



General View of Dredger looking Aft.

ering, was accomplished in 64 days, and after completing a very extensive series of dredging output trials, which were successfully carried out with an ample margin, she was handed over to her owners on the 4th July, 1935.

Since the "Chien She" was commissioned for service on the Yangtsze Bar the guarantee period has elapsed, and a description of the vessel and analysis of the actual dredging work accomplished during that period is of considerable interest.

The principal dimensions and other important particulars of the "Chien She" are given in the following table, as follows:

Particulars	English	Metric
Length overall	373-ft.	113.690 m.
Length B. P.	360-ft.	109.726 m.
Breadth, moulded	60-ft.	18.288 m.
Depth, moulded	26-ft. 6-in.	8.077 m.
Gross Tonnage	4,699-tons	4,774 tonnes
Net Tonnage	1,858-tons	1,887 tonnes
Load draught, normal	18-ft.	5.486 m.
Deadweight tons	4,500	4,572 tonnes
Hopper capacity, cubic yards, to top of coaming	4,200	3,210 cub. m.
Hopper capacity, cubic yards, to deck level ...	3,700	2,828 cub. m.
Maximum dredging depth	45-ft.	13.615 m.
Dredging output of solid in situ mud from the Yangtsze Bar of density 1.8 metric tons per cubic metre, dredged, transported in hoppers, deposited by hopper doors two sea miles distant from dredging base in a total of 10 working hours	25,000 cub. yards	19,110 cubic metres

The vessel has been built in accordance with the requirements of Lloyd's Register of Shipping under Special Survey, the classifications *100 A.1. Hopper Dredger having been assigned by that authority. The regulations of the Board of Trade have also been fully complied with.

General Arrangement

The photograph of the dredger "Chien She," illustrates the vessel in service condition, which to all outward appearance resembles that of a modern cargo steamer rather than a typical drag suction dredger.

The vessel has a raked stem of rounded plate form, and elliptical stern, a single funnel and two tall masts. The rudder is of double plate type of stream-lined design and electrically welded construction; the steel castings having been supplied by the Builders' Steel Works at Elbing, who also manufactured the stern frame and shaft brackets. The hull plating is bossed in way of the two lines of shafting, and extends aft to the propellers.

Closer views of the vessel, looking forward and aft, are also shown.

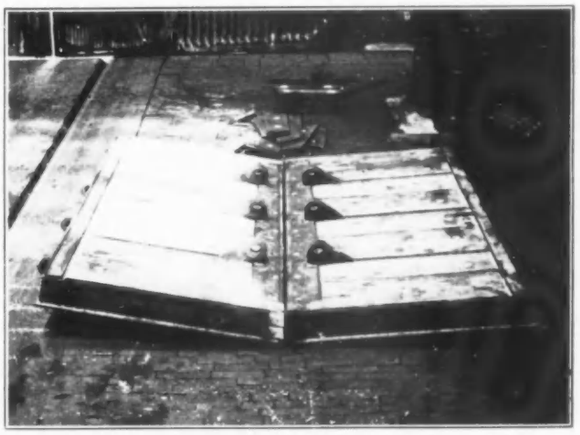
Watertight sub-division is effected by six transverse bulkheads, all of which extend to the level of the main deck, with the exception of the bulkheads at the fore and after ends of the hopper spaces, which are carried up to the upper deck. The vessel is further sub-divided longitudinally by a centre well amidships, in which the suction pipe and dredging ladder is situated. Forward of the well is an additional watertight compartment through which the suction pipe passes to the dredging pump. This compartment is provided in case of damage to the well during dredging, and also contains the hydraulically-operated main sea suction, shut-off valve.

On either side of the centre well is arranged the spoil hoppers, constructed with sloping sides, which form large buoyancy spaces at the ships' side and centre well sides respectively. The outer spaces have extra deep floors plated over and arranged as feed water tanks, built with recesses in way of the sea suction valves to hoppers; the tank top plating and connection to ship and hopper sides being of welded construction. The spaces at the centre well side are utilised for the installation of the main suction pipes and valves from the hoppers.

The peak tanks have a large capacity arranged for trimming purposes. A summary of the capacities of the various fuel bunkers and tanks for fresh water and water ballast is given below:—

				Tons
Bunkers:—				
Cross bunkers oil fuel,	6,740 cub. ft.	Coal,	6,460 ...	145
Starboard bunker ,,	12,050 ,,	,,	10,300 ...	228
Port bunker ,,	12,350 ,,	,,	10,510 ...	232
Settling tanks ,,	1,000 ...	...	... ...	
		Total Coal Capacity	...	605
Fresh Water:—				
Feed water tanks, port				127
Feed water tanks, starboard				127
Drinking water tanks				18
		Total fresh water	... ...	272
Water Ballast:—				
After peak				154
Fore peak				156
		Total water ballast	... ...	310

A large cargo hold is arranged forward for the storage of wire ropes, stores, and spare dredging equipment; aft of which is the pumping engine room, the hopper spaces, boiler room and propelling engine room respectively, whilst an insulated and refrigerated chamber, having a storage space of 600 cu. ft. in three compartments, is situated in the tween deck aft.



A Pair of the Hopper Bottom Doors.

Accommodation for Officers and Crew

The accommodation for the captain and dredging master, first officer, and chief engineer, is arranged below the bridge deck, together with the wireless room and office. On the main deck aft six additional cabins are provided for the deck and engine-room officers. The cabins are unusually large, well ventilated and comfortably fitted out for the tropical weather conditions under which the dredger has to work during the summer months. The steel decks forward and aft in way of all accommodation are sheathed with teakwood planking.

The Dredger "Chien She"—continued

Cabins for the Chinese senior ratings, including: dredging loadahs, wireless operator, engine-room artificers and armed guards are arranged forward, at the port and starboard sides of the pump room casing. In the 'tween deck forward, light and airy accommodation is provided in four separate spaces for sailors, oilers, firemen, cooks and boys, fitted up with steel-frame berths, lockers, and tables. The forecastle deck is of teakwood, and the 'tween decks in way of crews' space of Oregon pine.

Well-fitted bath rooms and toilet facilities are arranged in conjunction with the officers' and senior ratings' accommodation, whilst spacious toilet room, lavatories, and wash-houses, are provided for the use of the crew.

On the poop deck aft is situated a suite of three state rooms, with bath room and toilet adjoining for accommodation of the Board's officials and dredging engineer during inspection visits to the dredger.

The full complement of the vessel is as follows:—

	Persons
Captain and Dredging Master, and Deck Officers	4
Chief Engineer and Engineer Officers	5
Chinese Senior deck ratings and Medical Officer	15
Chinese Senior engine room ratings	13
Sailors 18, Oilers 7, Firemen 20	45
Steward 1, Cooks 6, Boys 7	14
Other non-ratings	10
Total	106

Navigating Equipment.

The outfit of magnetic compasses has been supplied by Messrs. Kelvin, Bottomley and Baird, Ltd., of Glasgow, and comprises two of this firm's "Kelvite" pattern liquid card instruments, supported on a solid teak pillar with patent suspension.

As previously mentioned, a British Admiralty silent magneto-striction, echo sounder with recorder, supplied by Henry Hughes and Son, Ltd., is installed for taking soundings over the dredging area.

Messrs. Siemens have supplied the installation of loud-speaking telephones communicating between the navigating bridge and the steering position on the poop deck, and between the propelling and pumping engine rooms, all inter-connected. The same firm has also installed an electric indicator for the ship's navigating lights and dredging signals.

A "Teledep" draught and displacement instrument supplied by Messrs. Dobbie McInnes and Co., Glasgow, is installed in the operating room for indicating the conditions of loading in the hoppers during dredging.

Turnbuckles and Shackles for Hopper Door Gear.

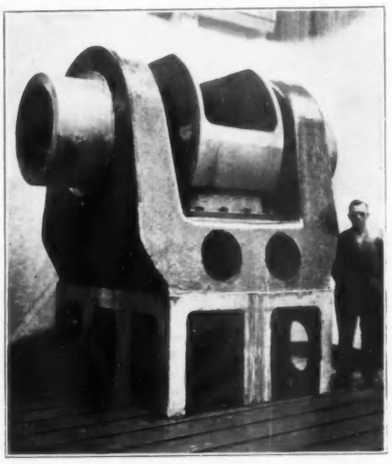
Dredging Arrangements and Equipment.

The main hoppers, which are situated on either side of the centre well, amidships, have an aggregate capacity of 2,850 cu. metres (3,700 cu. yds.) to deck level. The hoppers are constructed with sloping sides, with cross girders at bottom, which divides each hopper space into ten compartments, open at the bottom, and closed by means of a double row of steel cased doors lined with oak wood. The doors are supported on strong forged-steel hinges, fitted with manganese steel pins and bushes, and when closed press against oak wood frames lined with leather jointing. Each door is raised by two steel-wire strops, fitted with stretching screws, and connected to equalising gear in order to ensure equal loads on all the supports.

Each pair of door wires is further connected to a second equalising gear, to which is attached the main chains leading to a sliding motion girder running along continuous gangways on the hopper tops. The sliding girder for opening and closing the hopper doors is actuated by means of a hydraulic ram situated one on either side at the after end of the hopper gangways. The rams are arranged to work at a pressure of 600 lbs. per sq. inch.

This arrangement makes it possible to operate each pair of doors separately, or any number of them together.

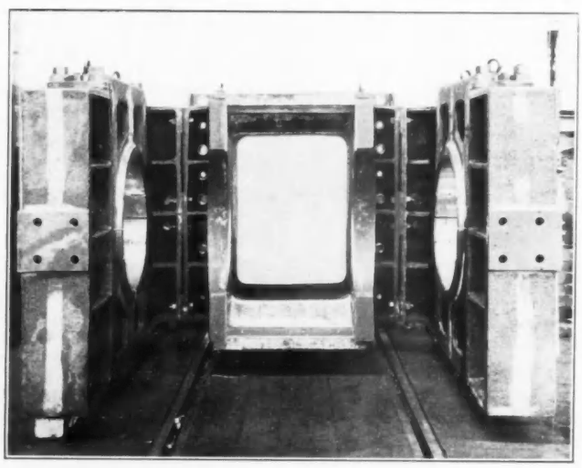
During loading of the hoppers the main-door chains are supported by means of a forged steel cottar secured to a cast steel stool on the hopper gangway, which also forms the sliding faces for the hydraulic motion bar.



Sliding Joint and Trunnions of Suction Ladder.

Perhaps the most interesting part of the whole dredging gear is the dredging head, or drag head, and the outboard suction pipe for conveyance of the dredged material to the pump. The utmost care has been taken in the design of this equipment in order to reduce to a minimum friction losses at the drag-head entrance and in the suction pipe, and with this object in view the various parts and sections have been made of stream-line form.

The suction pipe is arranged in a strong girder frame of steel plate and angle construction, secured to massive steel castings at either end; the lower casting being arranged with bearings and shaft to take the drag head, the upper casting having side journals of large diameter, which are supported in heavy bearings secured to the centre well sides. Attached to the upper casting is a cast steel machined sliding joint, which rotates in a steel casting secured to the forward end of the centre well



Side Bearings and Opening for Suction Sliding Joint.

plating, the joint being made watertight where the sleeve passes through the hull, and connects to the main suction pipe to the dredging pump.

The dredging pump has been kept as low as possible, in order to reduce the suction lift.

(To be continued)

Port Traffic at Helsingfors.

It is of interest to note that during the month of June traffic at the Port of Helsingfors was very active, being much in excess of the figure for the corresponding period of last year. A new warehouse at Skatudden is approaching completion and will be ready for use by September.

Notes of the Month

New Port Facilities in Ethiopia.

The Italian Cabinet has approved a six years' plan for the exploitation of Ethiopia, which plan includes the construction of new port facilities at Mogadiscio, Brava and Merca, and a set of roads connecting these ports with the interior.

Seamen's Hospital in London.

The foundation stone for a new hospital under the auspices of the Seamen's Hospital Society, was laid on July 13th near the Royal Albert Dock, London, by Lord Ritchie, of Dundee, Chairman of the Port of London Authority. A guard of honour consisting of the King's Bargemaster and six of His Majesty's Watermen was provided by permission of the King.

New Quay at North Shields.

A new quay, 400-ft. in length, at the entrance of the Albert Edward Dock, North Shields, has been completed and brought into commission as from June 29th. The quay, which is assigned to the Norwegian traffic and primarily to the services of the Fred Olsen Line between the River Tyne and Oslo, has been constructed by the Tyne Improvement Commission.

Trade at Liverpool Docks.

During the twelve months ended July 1st last, the Mersey Docks and Harbour Board report an increase in goods handled of 7½ per cent. over the quantity during the previous year. The tonnage of goods discharged or loaded rose from 14,500,000 tons to 15,600,000 tons. The receipts from rates and dues increased by £74,367.

Chinese Harbour Works.

The authorities of the Port of Whampoa on the Pearl River, near Canton, are endeavouring to obtain funds to finance the development of public works at the port, including the industrial expansion of the locality. The construction of a new harbour at Lienyum has given an impetus to overseas trade and a large ocean terminal is contemplated which will necessitate the extension of the breakwater and the deepening of the harbour.

Port Rates Reduction.

The Mersey Docks and Harbour Board have recently made a reduction in certain port charges. In lieu of 7½% at present allowed, a reduction of 10% is made in dock tonnage rates and wharfage rates payable on vessels. It was announced in connection with this decision that the total amount of tonnage coming into the Port of Liverpool and paying dock tonnage rates and harbour rates was greater than the previous record of the port in 1930.

Dredger for the River Seine.

The Ateliers and Chantiers de Bretagne recently completed at their Nantes yard the building of a big suction dredger, having a capacity of 1,000 cubic metres and a displacement of 4,000 tons. This dredger, named " Victor Guilloux " and fitted with soft suction pipes, is the first dredger of this type so far built in France. She is 90.85 m. long, with a breadth of 15 m. and will be used to increase the depth of water in the mouth of the River Seine.

Campbeltown Harbour Extension.

A proposal for the extension of Campbeltown Harbour, Kintyre, was the subject of consideration at a recent meeting of the Corporation. The Fishery Board originally estimated the cost of the work at £3,100, and the Treasury was prepared to make a grant of one-third of this amount, leaving the remainder to be raised locally. A revised estimate was now put forward as the result of the increased cost of materials, amounting to £4,800, and the Corporation decided to apply to the Treasury for an increased grant.

Trade at South Wales Ports.

The reports of the Great Western Railway Company for the past six months indicate a considerable improvement in the trade of South Wales ports. With the exception of Port Talbot, there is an increase in every case.

The total imports and exports to the end of June amounted to 12,741,757 tons, compared with 10,641,287 tons during the corresponding half of last year. Imports showed an increase of about 230,000 tons. Exports gave an increase of nearly 2,000,000 tons. The figures are 10,752,680 tons this year, compared with 8,880,893 during the first half of last year.

The increase in the export of coal was 1,800,000 tons; patent fuel increased by 50,000 tons; tinplates by 58,000 tons.

For the first six months of last year ships entering the South Wales ports numbered 8,241. This year they numbered 9,191. There are no Welsh ships idle in Cardiff.

Fruit Imports at Southampton.

During the season just drawn to a close, the Port of Southampton handled nearly all the deciduous fruit exported from South Africa, totalling 3,356,779 packages, in addition to 31,237 crates of fresh pineapples. The small quantity of fruit not shipped to the United Kingdom went to Scandinavia.

New Dock Gates on Order.

Orders have been placed with Vickers-Armstrong, Ltd., Barrow, for two pairs of dock gates. One order from the Great Western Railway is for a pair of 80-ft. steel gates for use at the inner end of the Basin, Barry Docks. The gates will be fitted with hydraulic sluices and hydraulic gate machinery. The second order is for a pair of steel gates for No. 2 dry dock at East India Harbour, Greenock. In both cases the gates will be constructed at Barrow, and the machinery at Elswick.

Cannon Dredged From the Tyne.

A brass cannon, about 3-ft. 6-in. in length, has been dredged from the Tyne by a Tyne Improvement Commission dredger near the new plywood works at Willington Quay. The cannon, which is in good condition, has some capital letters and the word " Portugal " on it and also a date which, however, cannot be correctly deciphered. The cannon was probably used to fire distress signals. It has been ascertained that in 1929 a Brazilian vessel lay near the place where the cannon was brought to the surface.

Proposed New Argentine Port.

An Act has just been passed through the Argentine Legislature authorising the construction of a coasting port in the city of Gualaguay (Province of Entre Rois). The Act states that the proposed port should be considered as a complement to the improvements at present being carried out in the River Gualaguay, in that district, and that it should be situated on the right bank of the river. It is to consist of a long quay with facilities for cranage and other discharging gear, a reinforced concrete pier and a slipway for small vessels and canoes. The scheme also provides for the construction of a number of warehouses and offices for the use of the port officials, the paving of the streets in the vicinity of the port and those having access to it, the installation of fire-fighting apparatus, a modern drainage and sanitary system, etc. The estimated cost for the whole work is about 475,000 pesos.

New Fishing Port in the Baltic.

A new fishing port has just been officially opened about 80 kilometres from Stockholm on the little island of Mellsten in the Danziger Gatt in the Baltic.

The port has been constructed with the object of facilitating the landing of fish for the fishers at present using the Port of Nynäshamn, perhaps best known outside Sweden as the port for the trip from Stockholm to the famous town of Visby on the Island of Gotland.

The Mellsten port, begun in 1935, has cost 217,000 kronor and has been carried out by the State as an unemployment measure. The entrance to the bay forming the harbour is protected by a 92-metres long breakwater of concrete on stone-filled timber caissons, with a 50-metre long concrete quay.

The Moscow-Volga Canal.

The Moscow-Volga Canal, the leading features of which were briefly described in the June issue of this Journal, has now been brought into commission, having been handed over for commercial exploitation to the Soviet Commissariat of Water Transport on July 15th. During a fortnight's experimental use, the traffic comprised 17,000 passengers and 18,600 tons of cargo, the latter mainly timber, minerals, building materials, peat and gravel. It is expected that during the navigation season of the present year, the number of passengers will exceed a million, and that there will be about 330,000 tons of freight. The passenger service will be run by four 700 horse-power motorships, developing a speed of 23 kilometres per hour. The distance between Moscow and Kalinin will be covered in from 18 to 20 hours, and ships will leave both points twice a day.

The cargo carriers on the canal will consist of a fleet of 300 h.p. tugs, two 200 h.p. screw steamers, 37 barges of an aggregate capacity of 35,000 tons, and eight 150 h.p. paddle steamers.

The total length of the canal is 128 kilometres. It shortens the water route from Moscow to Leningrad by 1,100 kilometres and from Moscow to Gorky by 110 kilometres. There are eleven locks besides a number of dams and barrages. The cost of the undertaking was 1,800 million roubles.

Wellington Harbour Board

Excerpts from Departmental Annual Reports for the Year ended 30th September, 1936

Report of the General Manager and Secretary

Trade of the Port

There has been a further increase in the total trade of the Port compared with last year, especially in the Import trade from overseas. Shipping Arrivals have also increased with the trade and this year's shipping total is a new record for the Port, almost reaching 4,000,000 net tons. The total trade of the Port was 2,012,460 tons, compared with 1,758,459 tons of the previous year, an increase of 254,001 tons, or 14.4 per cent.

Imports of all classes totalled 1,094,514 tons, an increase of 177,799 tons, or 19.4 per cent.; British and Foreign imports of all classes amounted to 548,685 tons, or an increase of 24.4 per cent.; Australian imports (108,298 tons) increased by 6,248 tons, or 6.1 per cent., and Coastal imports increased by 64,016 tons, or 17.1 per cent.

Transhipments to British and Foreign Ports totalled 56,770 tons, a decrease of 1,665 tons or 2.8 per cent.; Australian transhipments totalled 7,301 tons, an increase of 22.1 per cent., and Coastal transhipments remained about the same.

Outward cargo of all classes totalled 538,874 tons, an increase of 74,578 tons, or 16.1 per cent., as against 464,296 tons last year. Exports to British and Foreign Ports increased by 24,671 tons, or 14.2 per cent., to 198,482 tons. Australian exports, which amounted to 53,170 tons, increased by 24.8 per cent.; and Coastal exports increased from 247,866 tons to 287,222 tons, or by 15.9 per cent.

Shipping Arrivals

The total net register tonnage of trading vessels entering the Port during the year (excluding 33,649 tons representing warships, lighters, private yachts, etc.) amounted to 3,910,801 tons, which is 120,365 tons greater than last year. For comparison with those ports combining the arrivals and departures, the total net register tonnage of trading vessels that arrived and departed from and to overseas and coastal ports during the year was 7,581,965 tons.

Export and Import Values

The total value of all Overseas Exports from the Port of Wellington for the year ended 30th September, 1936, was from the H.M. Customs returns, £13,575,461 (including £21,245 specie), compared with £12,035,427 last year, an increase of £1,539,989.

The total values of all Imports, including Specie, computed in N.Z. currency, during the year, was £14,996,395, compared with £13,285,660 for the previous year, an increase of £1,710,735.

The total value of New Zealand Imports during the year ended 30th September, 1936, was £41,672,340, and of Exports £56,686,762, so that over 35 per cent. of the total Imports and 23 per cent. of the total Exports passed through the Port of Wellington.

Financial Results

The Receipts for the year were £478,987 19s. 11d., an increase of £81,625 5s. 10d., and the Expenditure £460,070 9s. 5d., an increase of £65,961 15s. 1d. The balance on the year's working was £18,917 10s. 6d., compared with £2,536 6s. 4d. last year.

The principal increases in revenue were in General Cargo Imports, Dock Dues, Pressing Wool for Export, and Hire of Plant, Cranes, etc.

The total Assets of the Board are now £3,198,024 14s. 0d., and the Liabilities £1,263,919 19s. 9d., the balance of Assets over Liabilities being £1,934,104 14s. 3d., an increase of £71,765 1s. 1d. This is made up principally by increases in Special Funds and in Sinking Funds.

The Board's debt liability remains the same, namely, £1,250,000 against which there are now sinking funds amounting to £713,849, leaving a net indebtedness of £536,151.

Pollution of Harbour by Sewage

Arising out of complaints received from shipping, the attention of the Wellington City Council was directed to the serious state of affairs that existed in connection with the City sewerage system as it affects the Harbour. For some years the Board has been complaining to the City Council of the amount of sewage that has been finding its way into the Harbour through the various stormwater culverts discharging within the radius of the City wharves. It has been admitted by the civic authorities that the present sewerage system is overloaded and that, instead of the ejector overflow pipes being used only for emergency and temporary cases of mechanical break-downs, they, in effect, have been called upon to act as relieving sewers and, as a result have caused the diversion into the Harbour of considerable quantities of crude sewage. Temporary steps have been taken by the City Engineer to improve the present state of things but, as far as the Harbour Board is concerned, it is evident that the present City sewerage system requires immediate attention and better provision made for the future. In a comprehensive report to the City Council, the City Engineer has made it clear that extensive additions, involving a large sum of money are required to the City sewerage system. This report has been adopted by the City Authorities. It cannot be too strongly emphasised that unless extensive improvements in the present City sewerage system are carried out at an early date, the position of the Harbour Board in regard to the use of these stormwater culverts as relieving sewers will require to be reviewed in order to prevent the cause of the complaints of the past.

Oil Pollution

One prosecution had to be made during the year. For allowing oil to escape into the Harbour, the Master of the "Doric Star" was prosecuted and fined £50, plus costs.

The duty is placed upon the Board to see that the Harbour is kept free from pollution of any kind. In order to ensure that the strictest precautions are taken on vessels against the escape of oil into the Harbour, continual vigilance is necessary and in any serious cases prosecutions must be instituted. Although the Board insists on all escaping oil being collected and cleaned up, this cannot always be done effectively and the residue, apart from its effect on fish and bird life, adheres to the wharves and sea walls, and causes discomfort on the beaches.

Trans-Tasman Air Service

During the year enquiries were received as to what facilities would be available at the Port of Wellington in the event of a Trans-Tasman Air Mail and Passenger Service by seaplane being inaugurated. After investigation, the opinion was expressed by the Company concerned in the enquiries, that the Wellington Harbour offered general surface and mooring conditions equal to, if not better than, any harbour in the world, apart from the fact that, due to its central situation, it would be a most convenient centre for the distribution of mails. So far no pronouncement has been made in this matter of a Trans-Tasman Service, but, in the event of a service being carried out by seaplanes, there are, according to experts, convenient and satisfactory facilities available at this port for such a service.

New Labour Legislation

During the year new Labour legislation affecting the employment and conditions of working of the permanent and weekly staffs of the Board came into operation. These involve provisions as to a 40-hour week, compulsory unionism, minimum scale of wages for clerical staff, and other relative matters.

As from 1st September all permanent and weekly employees of the Board covered by industrial agreements to which the Board is a party were granted a 40-hour week worked from Monday to Friday. Those employees not affected by such agreements remain on a 44-hour week basis.

The Report was signed by A. G. Barnett, General Manager and Secretary.

Report of Engineer

Thorndon Breastwork

Throughout the greater part of the year the Thorndon Breastwork was treated as a stand-by job, there being no immediate need for its completion. Towards the end of the year, however, the work was speeded up somewhat with the view of completing the concrete work before Christmas so that in the New Year the men and plant might be available for other work. At the end of September there remained only a few bays to be concreted.

The removal of the solid timber fendering at the southernmost end of the Breastwork and the construction in its place of spring fendering was finished during the year.

Harbour Survey

The re-survey of the depths of the Harbour Entrance has proceeded steadily during the year whenever the weather has permitted, but as the Heads are approached the interruptions have become more and more frequent. Particularly is this the case in the vicinity of Barrett's Reef where it is impossible to work except in the calmest weather. This is delaying the report on the question of erecting a beacon to mark the outer rock of the reef.

Floating Dock

Altogether 21 vessels made use of the dock, occupying it for 190½ days, or 62½ per cent. of the total working time. Of these, four dockings were of the Board's own plant, other

Wellington Harbour Board—continued

vessels being 17 in number and occupying the dock for 173½ days or 56.9 per cent. of the total working time. The average rate per ton per day paid in Dock Charges and Rental by the 17 vessels was 2.3 pence, a lower rate probably than would have been paid for like facilities anywhere else in the world to a dock owning institution that does not also undertake ship repairs.

Owing to the unfavourable weather in the earlier part of the summer and the length of docking of the " Rangatira " later in the year, it was impossible to treat the floor of the dock in a satisfactory manner, and extensive treatment will be needed during the coming summer. The insides of the walls, however, were effectively re-coated where the heavy bitumenous preparation had fallen away, and should not require further attention of any extent for some years.

The annual painting of the outside faces of the walls is having the desired effect, and only a few small spots are showing any sign of rust. It is desirable that the treatment be continued for a year or two longer to ensure that there is a thoroughly water-tight coating over the whole area.

Tractor Service

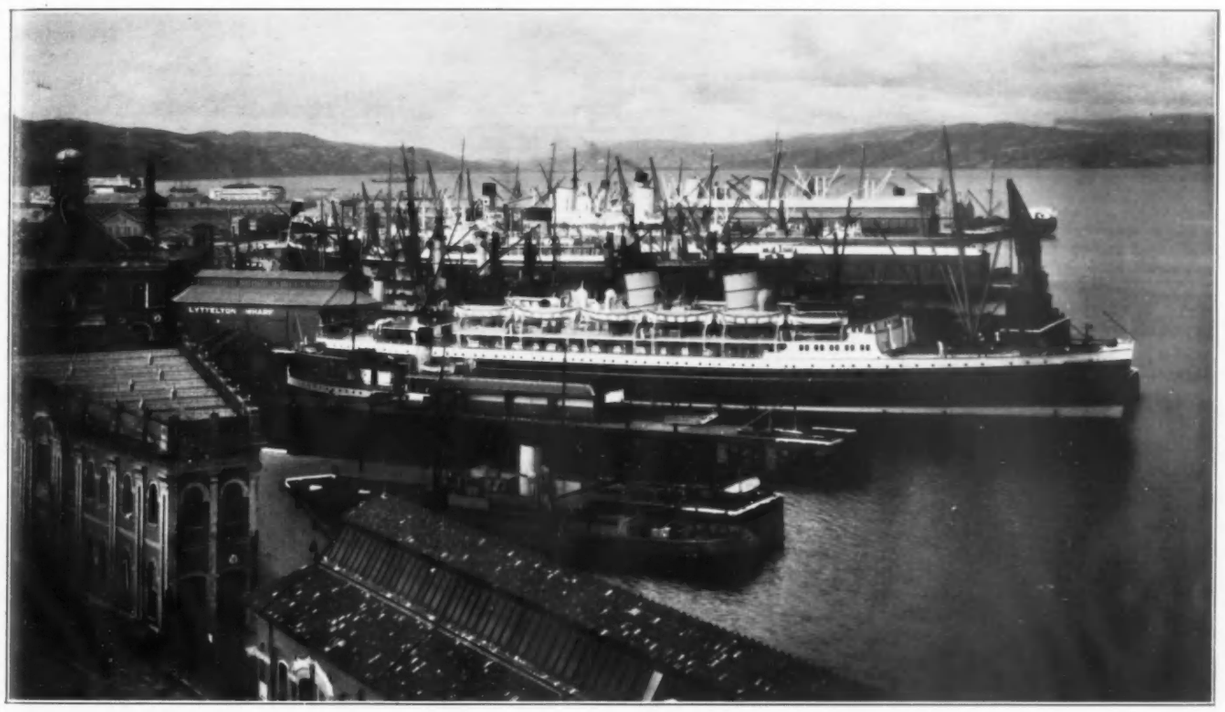
The tonnage of goods handled by the tractor service again exceeded all previous records, having reached a total of 347,833 tons, the quantity last year, which was at the time the highest recorded, being 273,786 tons.

The cost per ton of goods handled, including the cost of maintenance of the plant, together with interest and depreciation, was 11.05 pence, the previous year's rate having been 11.82 pence.

Store No. 49, Aotea Quay

In May the Board formally approved the plans for the proposed Store No. 49 at the extreme southern end of Aotea Quay.

The main dimensions of the Store are: length over all, 650-ft.; width, 102-ft. 9-in.; height under crane tracks, 24-ft., and under roof tie beams, 31-ft. 6-in. The floor area will be 64,100 square feet and the stacking space 1,158,000 cubic feet. Compared with Store No. 37 on the Pipitea Wharf, the floor area will be about 20 per cent. less, but the stacking space will be about 20 per cent. greater.



By Courtesy of] ***Wellington Harbour showing the Principal Overseas Wharves*** [The High Commissioner for New Zealand

Additional Cranes

The quotations for additional cranes that had been invited during the previous year, were considered by the Board in February and orders were placed as follows:—

Two-ton electric overhead travelling crane for Store No. 33, Messrs. S. H. Heywood and Co., Ltd.;

30-cwt. electric overhead travelling crane for Store No. 35, Messrs. Cowans, Sheldon and Co., Ltd.;

Two additional portal hydraulic cranes for the Glasgow Wharf, Messrs. East Ferry Road Engineering Works, Ltd., the makers of the original cranes.

With regard to the two cranes for berth No. 1 south, Queen's Wharf, alternative prices were obtained for hydraulic and electric power, and after due consideration the Board decided to instal electric cranes at this berth, placing the order with Messrs. Stothert and Pitt, Ltd.

With the provision of the two electric cargo cranes at Queen's Wharf No. 1 south, and of two additional large hydraulic cranes at the Glasgow Wharf, four of the old Glasgow Wharf cranes will be liberated. These will be transferred to Fryatt Quay, where a suitable crane track is being laid, and to the adjacent space between Stores Nos. 39 and 45, to assist in the handling of rough cargoes of steel bars, etc.

The 35-ton crane that stood between Stores Nos. 14 and 16, on Jervois Quay, was dismantled by the Board's staff and scrapped.

Miramar Wharf

The original low level jetty at Miramar, built by the Miramar Borough Council for purposes of the harbour ferry, being no longer of any use, has been removed. This will allow of the inner berth at the main wharf being lengthened by about 40-ft.

The store will be of reinforced concrete, carried on reinforced concrete piles, and will have a structural steel hipped roof covered with corrugated fibrolite sheets. It will have a central row of columns with provision on each side for overhead electric travelling cranes just as in Store No. 37. Externally on the seaward side there will be a track for the inner leg of semi-portal wharf cranes. In each corner of the store there will be two-storied offices to accommodate the storemen, clerks, Customs officials, watermen, crane attendants and others whose duties lie in and around the store.

Te Aro Reclamation

The area of Te Aro Reclamation between Taranaki Street and Tory Street lying to the seaward of Cable Street has been cleared, levelled and fenced. At the Tory Street end a yard for the storage of the Harbour Department's buoys and anchors, with an open store for the stowage of chain, etc., has been provided, and the remainder of the area is being made available for the handling of cargoes of heavy goods, timber and so on.

The Report was signed by E. D. Cachemaille, Engineer to the Board.

Two New Dredgers Under Construction.

Messrs. Ferguson Bros. (Port-Glasgow), Ltd., have received an order for a powerful dredger for the London, Midland and Scottish Railway Co. This will be the tenth dredging vessel constructed by Messrs. Ferguson Bros. for that railway company. The same builders have also received an order for a somewhat similar dredger for the Wellington Harbour Board, New Zealand. The machinery, in both cases, will be constructed by the shipbuilders.

Progress of Port Improvement at Marseilles

Present Position

I—Substructures and Railways

Works in Progress

Alteration of the Joliette Basin

THE Joliette Basin, situated in immediate proximity, accommodates the important traffic of the shipping lines serving North Africa and Corsica. Until recent years it had no jetties and the vessels were moored stern-on to the quay, an arrangement which necessitated costly double-handling of cargo and inconvenient conditions for passengers.

(a) Substructures

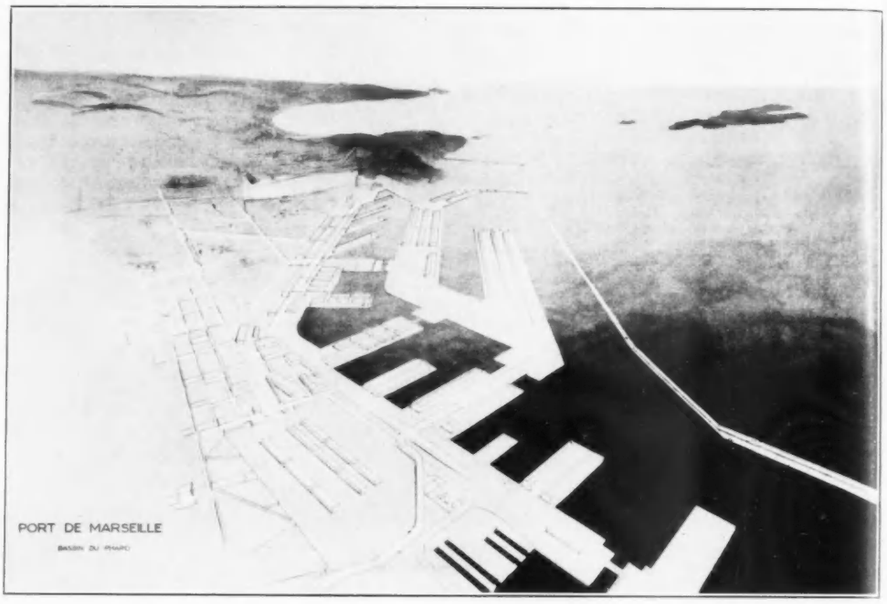
The improvements in this basin comprises:—

1.—The construction of two solid breakwaters, projecting respectively from the St. John Fort and St. Mary Lighthouse and enclosing the new outer harbour;

2.—The enlargement of the basin Southwards, by demolition of the Major traverse, which had restricted the water area, and general deepening to —8.50 m.;

3.—The construction of four oblique jetties, projecting from the quay on the East bank, numbered 1 to 4 from North to South, and the underpinning of the quays all round the basin thus enlarged. Jetties Nos. 1 and 2 are 300 m. long on their North face and 250 m. on the South; Nos. 3 and 4 are shorter by about 20 m.; the width of Nos. 1 and 3 is 62 m. and of No. 2 is 72 m. No. 4, of which the South quay serves a special purpose, as will be shown presently, is only 50 m. wide. The width of the docks between the jetties varies from 80 to 85 m.;

4.—The formation in the Southern part of the Joliette Basin, between Jetty No. 4 and St. John's Fort, of a small dock to accommodate canal barges and other small craft and which will also serve as a lay-by for floating plant and tugs. This dock is dredged to a depth of 5.50 m. below zero and has an effective quay length of about 600 m., including the South quay of No. 4 Jetty, where the Rhone barges are berthed.



Marseilles: Proposed Pharo Basin, Perspective View

The position of these works at the beginning of the year was as follows:—

(a).—Works completed:— Breakwaters at St. John's Fort and St. Mary's Lighthouse; Jetties Nos. 1, 3 and 4; Underpinning of the South quay and the Joliette traverse; Deepening to —8.50 m.; Demolition of the Major traverse.

(b).—Works in progress:—Jetty No. 2; Quays and reclamation round the small dock to the South; Filling in of the communicating canal.

(b) Railways

Rail service will be provided for each jetty by four quayside lines, two along the North and two along the South quay, and these will be connected with two running lines along the shore quay. Passenger traffic will run on two tracks at ground floor level of the maritime station. The railways of the Joliette Basin are at present connected with the Arenc Station by lines laid on the Lazaret and Arenc Quays, which are called "ballast lines," and it is proposed to connect them direct with the Joliette Station by a line crossing Joliette Place.

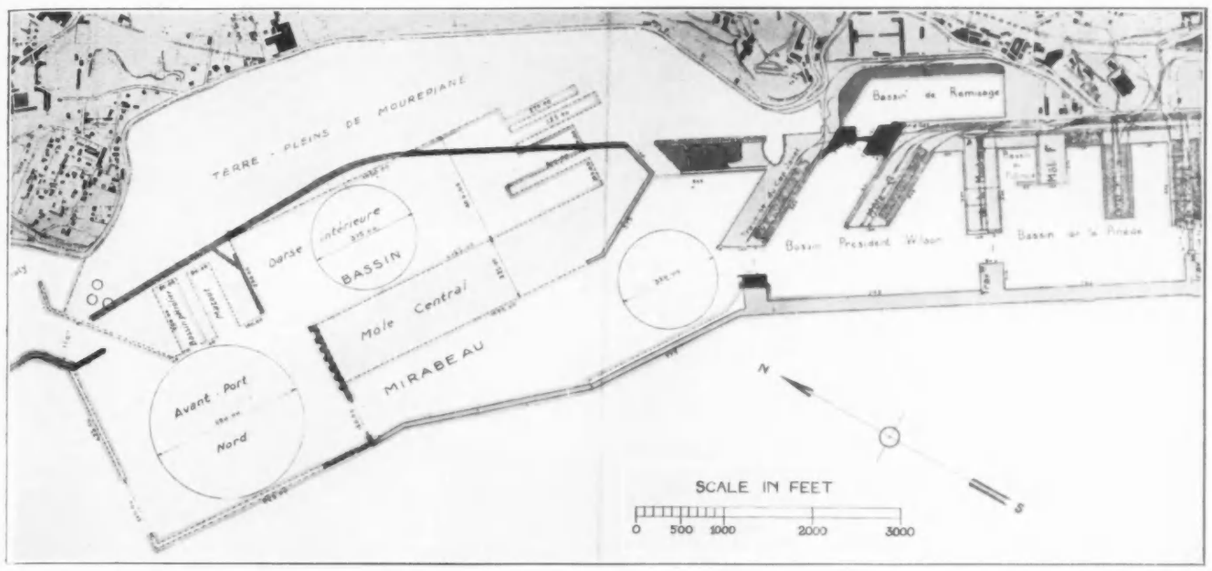
At the beginning of 1937, the lines on No. 1 Jetty and on the South Quay of the Joliette Traverse, together with their connection to the "gravel lines," were finished. The works comprised in laying down other railway lines are in hand and so arranged as to follow on in sequence after the substructure works and to enable every part of the new accommodation to be brought into commercial use as fast as it is completed.

The whole of this remodelling of the Joliette Basin is to be finished towards the end of the current year.

*See also previous articles in "The Dock and Harbour Authority" for May, 1928 and April, 1935.

Marseilles: Proposed Mirabeau Basin, Perspective View

Progress of Port Improvement at Marseilles—continued



Construction of the Mirabeau Basin

The formation of the Mirabeau Basin was declared to be a work of public utility by an Act of 24th October, 1919. Since that date, the layout of the project has been modified considerably and it now comprises the following features:—

An outer basin in which a turning circle of 550 m. diameter can be drawn and into which open:—

The entrance to the Marseilles-Rhone Canal, opposite Saumaty Bay;

Two petroleum docks, for handling "white" and "black" oils respectively;

An inner dock giving waterside facilities to extensive storage grounds;

Two graving docks and a repairing berth for vessels afloat, and

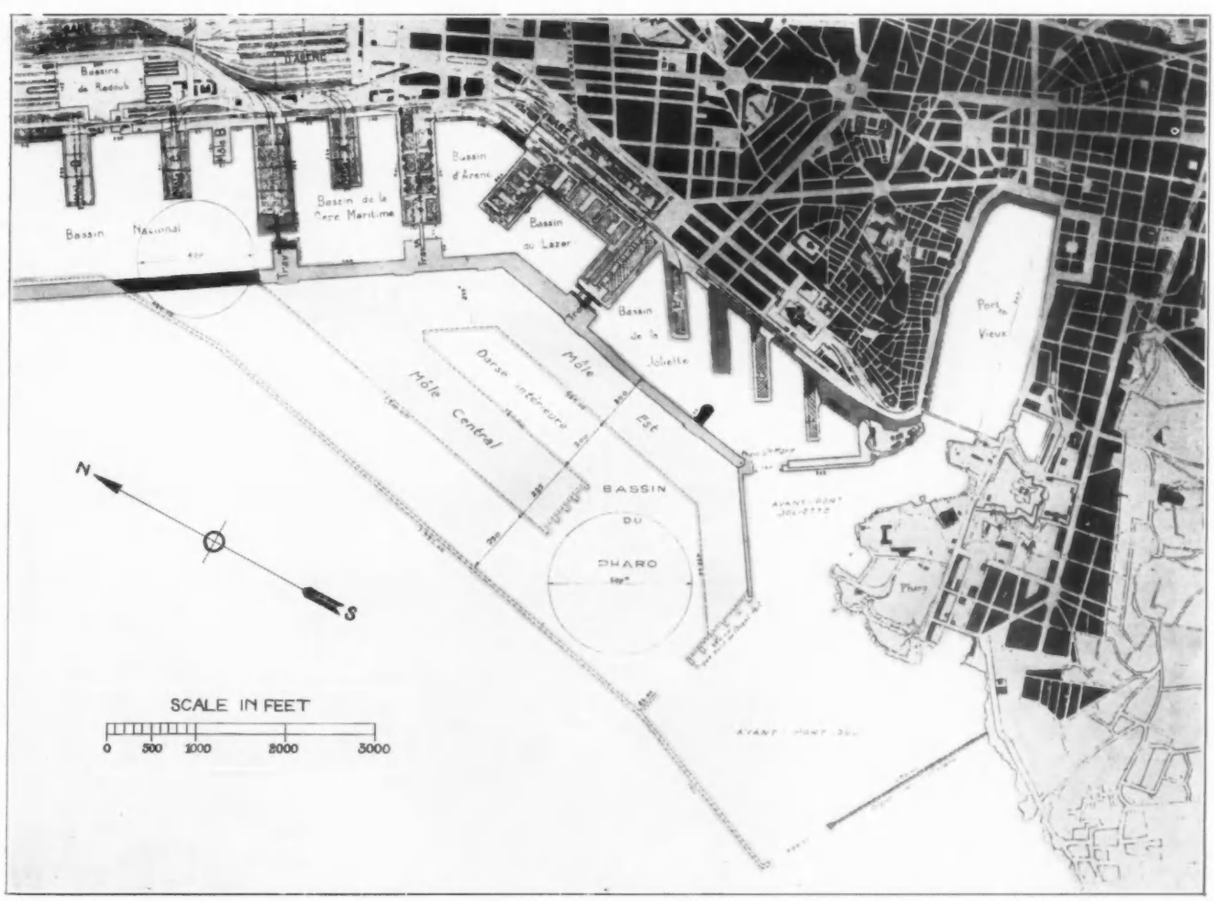
The channel leading to the other docks of the port.

Between the last-named access channel and the Inner Dock lies a large central mole or jetty, 225 m. wide, having quays on either side 1,125 and 1,025 m. long, and lying in a direction nearly parallel with the enclosing breakwater; their direction being that of the "Mistral" wind, so that ships berthed thereat are well placed in relation to this wind.

Between the root of the mole and the Cap Janet Traverse, lies a dock more than 300 m. wide with two quays, on its North and East sides, each 375 m. long.

The number of graving docks to be provided in the inner or middle basin is two, and their lengths are respectively 325 and 270 m. The width of the basin is 400 m.

Behind the East quay of the middle basin is to be formed, by filling up the present water area, reclaimed land called the Mourepiane Reclamation, which will create very large storage grounds. Here special plant may be installed for landing certain cargoes and there will be plenty of room for stock heaps.



Progress of Port Improvement at Marseilles—continued

Including this Mourepiane Reclamation, the Mirabeau Basin and connected works will comprise a total area of 300 hectares or 750 acres (350 acres of land and 400 acres of water) and 6 kilometres, or 3¾ miles of quayage.

The position of these works at the beginning of 1937 was this:—

(a).—Works completed:—The outer breakwater was built for a length of 1,325 m., of which 675 m. was of the conventional rubble wound type and 650 m. was vertical faced. The North and East Quays of the dock contained between the Central Mole and the Cap Janet Traverse—the South Dock of the Mirabeau section—are completed.

(b).—Works in progress:—Reclamation by filling is proceeding behind the East Quay of the Middle Basin, also between the South Dock and the shore.

Works estimated to cost 45 million francs were put in hand in 1936, with the object of forming a North Outer Basin in a temporary way by enclosing the Mirabeau Basin with a wall in line with the end of the proposed Central Mole.

Improvement of the Abattoir Passage

The Abattoir Passage really comprises two separate passages, each of 28 m. clear opening, divided by a central pier and crossed by a swing bridge. These passages have two defects in that they are too narrow and that neither of them is in line with the Arenc Passage.

It is necessary to create a new passage, having a width of about 60 m. With this object in view, it has been arranged to utilise here the swing bridge from the President Wilson Basin, which is to be moved to the Abattoir Passage lengthened by about 10 m. and substituted for the present bridge. This will save the expense of a new bridge and reduce the number of opening bridges in service. The removal of the Wilson Bridge, moreover, forms part of a very interesting improvement in the President Wilson Dock. It will permit of the Cap Janet Traverse being connected in a continuous line with the quay further inshore and a corresponding rectification of the quay line opposite, thus providing two new deep-water berths for liners. At the same time, the proposed alterations will afford room for ample access ways not only to the Traverse, but also to the quays of the South Dock in the Mirabeau group, which is now under construction.

The present swing bridge at the Abattoir Passage is in process of removal.

Proposed Works: Pharo Basin

The Mirabeau Basin is the last that can be formed towards the North, the coast beyond that becoming very steep and the depths very great. So future extension of the port at its Southern end is intended, by the formation to seaward of the existing basins of a large new one to be called the Pharo Basin. The construction of this new basin was declared to be of public utility by an Act of 10th April, 1932. Since then its proposed layout has been revised and contains the following features, approved by a Ministerial Order of 23rd April, 1936:-

(a).—An outer harbour called the "South Harbour," common to the Joliette and Pharo Basins, which will have a sheltered water area of 56 hectares (140 acres), with depth varying from 35 m. on the West to 6 m. on the East.

(b).—The basin itself, protected on the outer or seaward side by a breakwater 1,925 m. in length, parallel with the present outer breakwater of the Joliette Basin. The total area (land and water) protected by this breakwater will be 145 hectares, or 360 acres.

The internal arrangement of the basin will comprise:—

A turning circle of 500 m. diameter;

A channel, 250 m. wide, along the inner side of the breakwater, to afford access for shipping to reach the National Basin.

An inner dock, 200 m. wide, separated from the channel by a rectangular mole which has a quay length of 1,310 m. on the West side and 750 m. on the East.

A structure on the East of the inner dock, parallel with and forming one with the present seaward breakwater, which will have two lengths of straight quay, one 925 m. and the other 475 m. in length.

As regards depth of water, this is to be 12 m. for the quays on the East side and 14 m. for those of the Central Mole.

(c).—A new opening for access to the various basins and docks now constituting the Port of Marseilles, to be obtained by the demolition of the seaward breakwater for a length of 485 m. opposite the National Basin, so as to provide a turning circle of 400 m. diameter at the entrance to this basin.

Railway service to the new Pharo Basin will be by way of the Abattoir Traverse with direct connection to the Arenc Station.

The total length of quayage will be 3,950 m., or about 2½ miles; the cost is estimated at 420 million francs, or £3¾ million, at present rate of exchange.

Out of the whole programme, the parts selected for early execution are the breakwaters to enclose the South Harbour, commencing with the Southernmost, running straight out from the shore, in order to improve the protection of the Joliette Basin.

The estimate for this South or Outer Harbour is 105 million francs, nearly £1,000,000, of which 22 million francs, or £200,000, is for the South breakwater forming the first stage of the work.

The construction of this breakwater, called the Catalans' Breakwater, is being let to contract.

Widening the Joliette Passage

The Joliette Passage is that which communicates between the Joliette Basin and those of the Dock Warehouse concession, the Lazaret and Arenc Basins.

This passage, originally constructed in 1860, has a width of 20 m. only and an effective depth of 6 m. These dimensions had become quite inadequate for the needs of navigation. A project is in preparation to increase the width to 40 m. and the depth to 10 m. Measures will at the same time be taken to replace the hydraulic swing bridge now crossing the passage by a bascule bridge electrically operated.

Old Harbour: Underpinning of the Quay of the Belgians and Port Quay

This project provides for widening by 30 m. the Quay of the Belgians and by about 20 m. the Port Quay, and is being worked up in detail.

II—Improvements to Sheds and Equipment

The Chamber of Commerce adopted in 1926, an extensive programme of improvement and expansion of the equipment of its concession. The works contemplated comprise:—

(a).—The construction of sheds in reinforced concrete on the South quays of Mole G and of the Cap Janet Traverse.

The shed on Mole G is a two-storey building, 300 m. long and 37 m. wide, exclusive of verandahs of 4 m. projection. The Cap Janet shed is similar, but 330 m. long and 40 m. wide.

These sheds are completed and in use. The upper floors have been designed to permit of their employment later as maritime stations.

(b).—The provision of new electric cranes on the quays of the President Wilson Basin, so as to increase the total number of cranes at this basin to 29; 4 having a capacity of 10 tons, 5 of 2 to 3 tons, 14 of 1½ tons and 6 with double rating of 1½ and 3 tons.

These works are completed and the new cranes are in use.

(c).—The elimination of the hydraulic machinery of the other basin and its replacement by 62 electric cranes, of 1½, 3 and 5-ton capacity.

These alterations are being made by degrees, the change being now in progress in the Pinede Basin.

All the new electric cranes are run on direct current by means of three transformer sub-stations.

Equipment of the Joliette Basin

The equipment programme for this basin comprises the erection of two-storey sheds on each of the jetties and furnishing them with 3-5-ton cranes. In addition, to meet the special requirements of the trade in early produce from Algeria, the shed on the North jetty has two upper storeys; the sorting, checking and allocation of parcels of produce is done on the second floor and communication between this and the ground floor is effected by vertical conveyors capable of delivering 40,000 packages an hour.

The landing of passengers is provided for on the first floor level of these sheds, whence they are directed to a single maritime station serving all four of the jetties, being placed lengthwise on the shore quay to the East of the basin.

We have received from Messrs. Ruston and Hornsby, Ltd., a copy of a brochure illustrating and describing their latest Ruston Diesel locomotive suitable for work shunting. The locomotive weighs 7¼ tons and is driven by a 44/48 b.h.p. 4-cylinder Ruston oil engine.

New Dredger for the Mersey Docks and Harbour Board.

The first of two twin-screw 1,100-ton hopper dredgers "No. 24," fitted with three Priestman Grab Cranes for dredging to a depth of 60-ft. below water level, was launched by Messrs. Wm. Simons and Co., Ltd., from their yard at Renfrew, early in July. The vessel, which has a speed of 10½ knots per hour, in loaded condition, has been constructed under the direction of Mr. T. L. Norfolk, Engineer-in-Chief to the Mersey Docks and Harbour Board.

Destruction of Timber by Marine Organisms in the Port of Sydney

Excerpts from Supplementary Report No. 1

By R. A. JOHNSON, F. A. McNEILL and TOM IREDALE

INTRODUCTION

General Scope

IN the inaugural report (1932) it was admitted that monthly inspections of the timber test pieces at the various stations would have provided a much more critical record of attack, but time was not then available to carry out the idea because of the wide field of operations. Therefore the problem of fixing, in some definite form, the periods of the year which provide the greatest intensity of attack, and the periods in which the larval Cobra are distributed, had to be left for later attention. It would have proved an impossible task so to examine the thirty-seven stations in the port which were covered by the initial report and, consequently, only a few could be observed concurrently. It is hoped, however, similarly to deal with others as time goes on. Surveillance of a batch of four control test stations on a monthly basis was finally decided upon as being the limit which the available staff could manage. In the circumstances the field observations were carried out by R. A. Johnson. F. A. McNeill collaborated in the preparation of the text of the report and in laboratory work, the latter including the examination and checking over of specimens and conditions of attack. During the progress of the work the matter was referred to Mr. Tom Iredale for comment and checking. As in the past, special acknowledgment is due to Mr. A. J. Debenham, Engineer-in-Chief, for his encouragement and interest in the continuance of the research.

Portion of a 3 in. × 3 in. oregon control test sample attacked by Cobra borers alone. Example of 100% stage of internal destruction, a condition to which the comparatively intact surface of the timber does not provide a true index.

The four selected stations were situated in localities showing an attack almost entirely due either to crustacean or molluscan borers. In this regard, Stations 31 and 32 at The Spit and Manly respectively, promised the greatest variety of Mollusca, and Stations 9 (Pyrmont) and 28a (Lavender Bay) it was hoped would provide attacks mostly by Crustacea. At Station 28a, however, it was subsequently found that the attacks were of a general nature, due to both molluscan and crustacean borers. No results have yet been published concerning Station 28a; it was established about 1931, for the purpose of compiling information intermediate to Stations 28 (Ball's Head) and 29 (Neutral Bay).

In the present report the full results from Stations 32 (Manly) and 9 (Pyrmont) are treated in detail. Their entirely opposite results provide a most interesting comparison for presentation. Time has not been available for the elaboration of the data concerning the other two stations under discussion at the moment; these will form the main subject matter of a subsequent report.

Methods Adopted

In the initial phase of the investigations the methods adopted included the use of Oregon fir timber samples as controls at each testing station for the purpose of obtaining rapid and readily discernible results. A similar practice has been adopted for the present determination of the Annual Cycles of Attack, which have yielded data that can be applied to all classes of timber used for marine structures in the port. The employment of hardwood test samples, as previously, was not considered necessary in the present operations, as all the various species of timber must be more or less susceptible to borer lodgment and damage at the times and during the periods determined for the more readily attacked Oregon fir. And as all of the Oregon samples suspended in the water covered the various zones of borer attack previously determined for the port, they also provided a true index for wharves of hardwood structure in this particular regard.

The fact that the hardwoods normally used for marine structures are not destroyed or register attacks in the same manner as Oregon, is due to the various reactions of the timbers to marine borers. For instance, hewn ironbark, as used for fenders, has been observed to be practically immune to "Limnoria," but has very little more resistance to Cobra attack than Oregon. Further, turpentine in log form, as used for piles, normally succumbs comparatively slowly to "Limnoria" and Cobra to the limits of the sapwood, while the core wood may also be similarly destroyed by "Limnoria" when that borer is able to gain access. The borer "Chelura," normally associated with "Limnoria" in attacks on softwood, is rarely met with in the same circumstances in the hardwoods at present in use, which appear to be immune to its depredations.

The method of determining the Annual Cycles of Attack followed the routine as outlined hereunder.

Timber Test Samples.

At Oregon timber control sample was immersed each month at the aforesaid stations, and examined at monthly intervals thereafter, i.e., a fresh sample was immersed at each successive inspection following the placing of the initial sample, until the total of twelve had been placed in position. Now and again samples were not examined in strict conformity with the above routine, and instances will be noted in the detailed observation notes. Stress of time was mainly responsible in these cases, but it is trusted that little or no information of value has been missed effecting the continuity of the various reactions of the samples.

The samples were each 5-ft. long, with a cross section of 3 × 3 inches, and were suspended with counter weights attached to the lower ends so that the upper ends were exposed for 2-ft. at low water during ordinary spring tides; high water during ordinary spring tides gave 3-ft. of cover. As previously indicated, the position of the Oregon control samples in the water was carefully calculated, and intended to bring them into contact with attacks by marine borers in an area where the most severe destruction was suffered by the permanent structures of wharves, etc.

Inspection Procedure

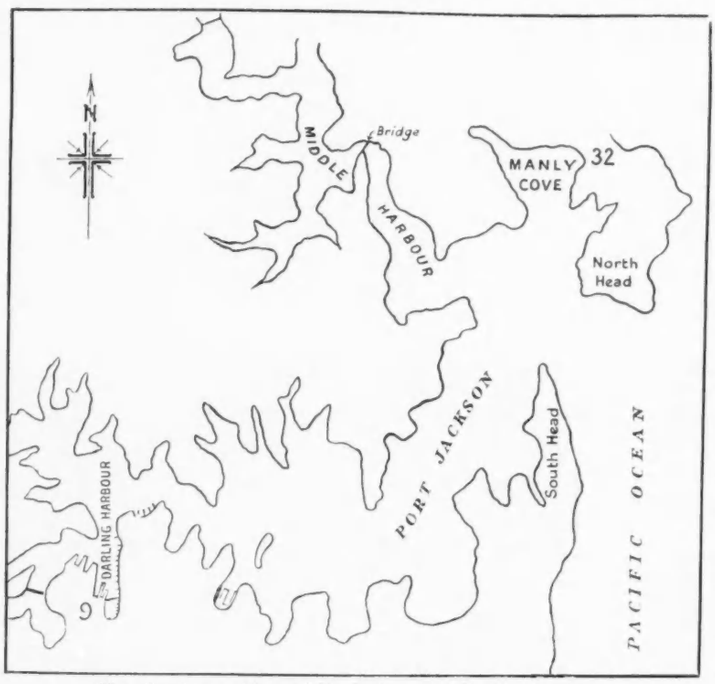
At each inspection a routine method adopted was to saw a small section from the lower end of a sample undergoing examination. This enabled the adequate compilation of definite facts concerning internal attack. Many check cuts, additional to primary ones, did not disclose any further information. Due allowance was always made for the Cobra mortality caused by the above method, which never failed to uncover an attack capable of assuming serious proportions. With Cobra attack the destruction was found to be uniform from the lower end of the control test samples to a point slightly above low-water mark. On the other hand, attacks by crustaceans gave quite a different registration. In most cases, the last-named were found to register their greatest percentage of destruction on the samples in an area slightly above low-water mark. Thus assessment of external crustacean attacks on the control test samples could not always be faithfully determined by the evidence obtained from a lower end section cut. Therefore the maximum destruction total quoted in many parts of the observation details of Station 9 (Pyrmont) is of necessity based on caliper measurements at points higher up the samples.

Destruction of Timber by Marine Organisms—continued

As opposed to the method of assessing destruction by Cobra borers, which is based on the reduction of internal timber fibre, it is possible to determine the degree of destruction by the crustacean borers " Sphæroma," " Limnoria " and "Chelura" in a much more complete sense. Hence the ultimate stage of a control test sample destroyed by boring crustaceans generally, is a state of practically complete destruction.

A very noticeable condition of the crutacean borer attacks on the Oregon control test samples was a slowing down of the rate of destruction as the higher percentages were registered and the surfaces available for attack became reduced in area. This fact seems worthy of notice, and will enable a reader better to appreciate the true significance of destruction rates as set out in the graphs and observation details on later pages.

In strict conformity with the practice adopted during the investigations covered by the initial report (1932) the terms very light, light, medium, heavy and very heavy, are used



Map showing positions of Manly Cove and Darling Harbour.

to indicate degrees of destruction. Each term has its percentage value, as follow: very light = 1 per cent., or a mere noticeable presence; light = 3 per cent.; medium = 6 per cent.; heavy = 10 per cent.; very heavy = 15 per cent. Stages in cross-sectional disintegration in excess of those just enumerated are stated in plain percentage form. Measurements of damage were always assessed on the condition at the point of most intense attack on a control test sample.

Similar terms to those just enumerated are used for stating conditions of marine growths during the inspections of the control test samples. In these cases, however, the terms are intended to have only a relative value.

All details were noted which were considered to have a bearing on the objective already outlined. Such data were calculated to be of assistance to an engineer in charge of harbour maintenance in any effort directed towards the eradication of marine borers. The facts accumulated by the procedure adopted are essential for determining at least the approximate time of the year when the maximum efforts for extermination should be made, thus obviating the waste of time and material following a decision based on guesswork alone. Also the assembled data indicate the presence of various types of borers, their abundance at specified times, and the nature of the attack which would have to be resisted by any timber used for marine work in the localities covered by the completed observations in this report.

A further use for the detailed facts of inspection presented is their application in cases where borers of similar type and relative abundance of the same may be met with in localities within the port other than the specific ones which have received critical observation. Therefore the reader will appreciate the importance which attaches to a recording of results, stage by stage, as here offered for dissection.

Graphs. Water Conditions.

The full history of each test sample of timber is given hereafter, and from this further deductions may be drawn by the reader or student over and above those specifically mentioned. Graphs have been prepared which specially illustrate the facts established in the text, and these provide an additional guide for quick reference. In the observation details water conditions at each of the two selected stations under present review (temperature excepted) are only stated as average figures. These averages, however, are calculated on the figures available since the inception of the marine borer investigations at the beginning of 1927. Owing to the wider fluctuations in temperature, regular fresh readings were taken, and these monthly records are specially indicated. Temperatures quoted on the graphs, however, are averaged. Check determinations for salinity have occasionally been made, but only when abnormal changes in the state of the water were suspected. Similarly, check oxygen and hydrogen ion quantities were only intermittently worked out. The water temperatures are stated in degrees Fahr., and the readings taken from a thermometer immersed to a depth of 12 inches below the surface.

General Borer Activity.

In observation details of stations, all teredinine borers are referred to under the local vernacular name of Cobra. The crustacean borers, as previously, are given their technical designations.

Respecting damage to turpentine timber, it has previously been recorded that marine borers were responsible for some very definite destruction of test samples (see detailed station histories, initial report, 1932). In the most advanced cases of attack, however, it was the sapwood that suffered during that earlier period of the investigations. Possible confusion on this point has been allayed by subsequent observations prompted by the tests made with standard timber samples, proving that the same conditions of attack are applicable to wharf piles of turpentine. Stress is laid on the fact, because the comparative ineffectiveness of turpentine sapwood is contrary to popular belief.

When the bark is present on turpentine piles, it has been found commonly to form a natural protection against the effective establishment of lodging Cobra larvæ. While the same bark is not entirely proof against the attacks of the crustaceans " Sphæroma " and " Limnoria," it considerably hampers their progression. Further, " Limnoria " will attack the sapwood of turpentine and also the heartwood when access to the latter is possible; other than in exceptional cases, it does not attack the true wood (lying immediately below the sapwood) either in test samples or wharf piles. The same borer is capable of working in any depth of water, but the most intense infestations occur within the limits of the inter-tidal zone. No part of either test samples or wharf piles of turpentine is absolutely proof against " Sphæroma " attack.

The reader will note in the observation details that 100 per cent. destruction was several times registered by Oregon control test samples at Station 32 (Manly), which were attacked by Cobra borers with a maximum diameter measurement of only 3/16-inch. Elsewhere, it is stated that this measurement would represent a growth of three months. Therefore it may be clearly seen that in cases where intense infestation by Cobra borers occurs, destruction to the 100 per cent. stage may be accomplished by animals little more than juveniles in age and dimensions. Definitely it does not require fully-grown Cobra animals to effect ultimate destruction at least in softwood.

Regarding stunting of Cobra borers, it is now believed that this occurs only if a timber be unfavourable because of the presence of natural or introduced toxins.

General ratio of destruction as between the various marine borers in Port Jackson cannot be set out as applicable to the port as a whole. Ratios vary in different localities, as already proved in the detailed observation matter as set out in this and the initial report. An important fact that can, however, be stated, is the relative rate of borer destruction as demonstrated at the two control test stations reviewed in this report. At Station 32 (Manly) the dominant Cobra destruction of the Oregon control test samples registered a rate four times greater than the dominant combined " Limnoria " and " Chelura " attacks at Station 9 (Pyrmont). It is considered that this figure would be maintained in reference to hardwood of any one particular species.

A fortunate feature of the destructive work of the largest crustacean borer (" Sphæroma ") in the port waters is its comparatively slower progress, confined to areas of wood between high and near low-water mark. With this form of borer, no part or section of any kind of timber in the form of either test sample or wharf pile is completely immune to attack in Port Jackson. Marked destruction is illustrated by the photos showing the result of " Sphæroma " attack on turpentine piles after five years' immersion. Also, many turpen-

Destruction of Timber by Marine Organisms—continued

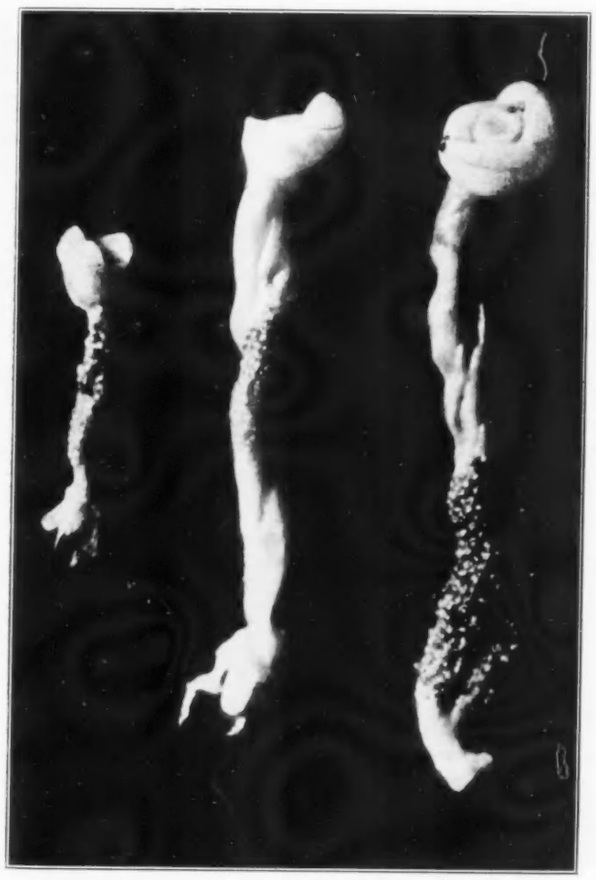
tine piles in Walsh Bay, Port Jackson, have been so reduced in section, mainly by the ravages of "Sphæroma," in fourteen to sixteen years, that they had to be either withdrawn or repaired. In the ports of Newcastle, New South Wales, and Brisbane, Queensland, "Sphæroma" is much more abundant than in Port Jackson; it works faster, and is responsible for increased destruction.

Seasonal Influence

It is not expected that the yearly cycle of attack for any one locality will coincide exactly during any one monthly period in different years. This is because of slight variations in the duration of seasonal influences, when both Cobra and crustacean borers may be affected. The time of the year embracing the most intensive periods of attack, however, will show only slight variation. Some check tests made to date at Station 32 (Manly) show that from November to January almost exact coincidence of Cobra borer activity is obtained. Incidence of borer activity for the months of April and May in different years, however, is likely to show some inconsistence worthy of notice. About this period of the year, as suggested, there is some variation in the time when the maximum temperature is reached and the water begins to lose its warmth.

Behaviour of Crustacean Borers

When the crustacean "Chelura" ultimately joins with the smaller form "Limnoria" in an attack on softwood, it almost invariably hinders for a time the destructive operations of the latter, and when in numbers dominates the attack. "Chelura" is a most active and virile animal, and may on occasions almost completely overwhelm and displace its smaller associate. This is particularly noticeable in the more accessible surface layers of timber. Often the final condition of such an associated attack is to find "Limnoria" occupying only the innermost and less accessible burrows.



Greatly enlarged small examples of sexually mature Teredo pertingens taken from an oregon control test sample, each with developing internal bivalve larvae clearly defined. The smallest and complete example measured one inch in length and $\frac{3}{32}$ inch in diameter. The period of growth covered is slightly less than two months from the time of larval lodgment.

Where Cobra has made an early and intense attack on a control test sample, the rapid internal destruction produces a marked effect on potential intensive external destruction by the crustacean "Limnoria," or "Limnoria" and "Chelura." In such instances the extent of internal destruction by Cobra is not generally apparent from the outside, but often there remains little or no timber fibre further to sustain or encourage the attentions of the crustaceans named. In the circumstances, they almost invariably either gradually die out or desert such a location. This habit is described in the next section.

A fact established in respect to the presence of either thin or thick layers of harder autumn growth in Oregon timber (sometimes termed fine and coarse grain), is the absence of any difference in the rate of destruction by "Limnoria" and "Chelura." Certain it is that the harder layers of wood are temporarily left during the progress of an attack, and the softer spring wood is bored out to quite an appreciable depth. Ultimately, however, the harder layers are undermined, and those portions not consumed are washed away. In this way is equalised the rate of destruction in these two conditions of a softwood timber.

A dissected chip of oregon from a control test sample. The apparently intact surface layer has been removed to show a cross section of the numerous bore holes of young Cobra ½ inch below.

It is to be noticed from reading the observation details of Station 9 (Pyrmont) that the borings of "Sphæroma" in the Oregon control test samples were always ultimately undermined and destroyed by the main crustacean attacks pursued by "Limnoria" and "Chelura." On the surface of hardwood, however, the reverse is the case. Here "Sphæroma," as previously emphasised, readily establishes itself and bores at a more accelerated rate than its smaller relatives. In the latter circumstances the boring rate has not been measured, but the most recent investigations have provided some evidence in respect to softwood, as determined in the observation details of the Dec. Sample (Pyrmont), inspection 1st May, 1933. There it is noted that "Sphæroma" bored in the Oregon control test-piece at the rate of a quarter inch per month, and attained full adult dimensions (approximately half an inch) upon reaching a depth of three-quarters of an inch in a period of three months.

(To be continued)

Presentation of Long Service Certificates.

An interesting event in the history of the Tilbury Contracting and Dredging Company, Limited, took place on Monday, 26th July, 1937, in the Board Room at Tilbury House, Westminster, S.W.1, when the Company's Long Service Certificates were presented to all members of the staff and employees with a minimum of 25 years' service. The presentation was made by the Chairman, The Rt. Hon. Lord Southborough, G.C.B., G.C.M.G., who pointed out that the period of service ranged from the minimum of 25 years to as long as 52 years, and that of the average number of 600 employed regularly by the Company 70 of those were now entitled to receive Long Service Certificates—a splendid achievement, of which any Company might well be proud. Lord Southborough was supported by Lt.-Col. Sir John Chancellor, G.C.B., G.C.V.O., Mr. Cutler Jones, and Mr. Arthur Hughes, the Managing Director.

Destruction of Timber by Marine Organisms—continued

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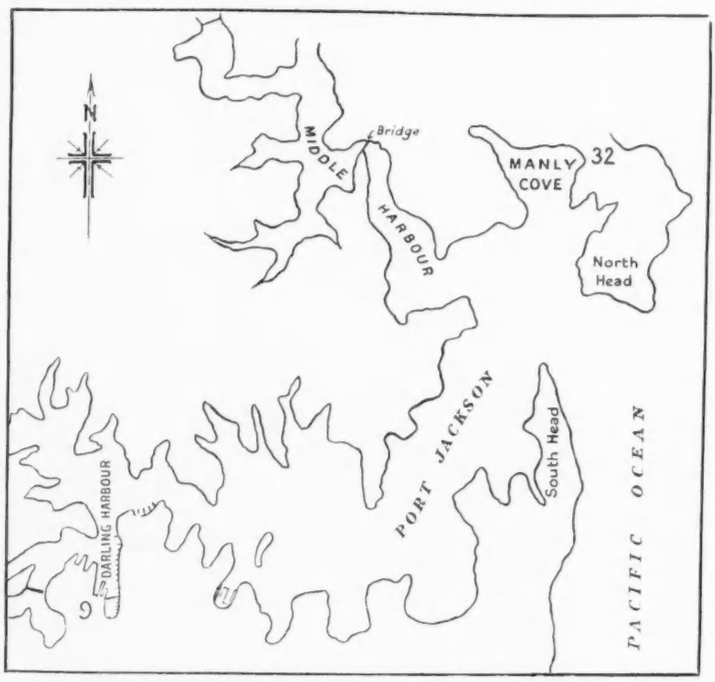
A very noticeable condition of the crutacean borer attacks on the Oregon control test samples was a slowing down of the rate of destruction as the higher percentages were registered and the surfaces available for attack became reduced in area. This fact seems worthy of notice, and will enable a reader better to appreciate the true significance of destruction rates as set out in the graphs and observation details on later pages.

In strict conformity with the practice adopted during the investigations covered by the initial report (1932) the terms very light, light, medium, heavy and very heavy, are used



Map showing positions of Manly Cove and Darling Harbour.

to indicate degrees of destruction. Each term has its percentage value, as follow: very light = 1 per cent., or a mere noticeable presence; light = 3 per cent.; medium = 6 per cent.; heavy = 10 per cent.; very heavy = 15 per cent. Stages in cross-sectional disintegration in excess of those just enumerated are stated in plain percentage form. Measurements of damage were always assessed on the condition at the point of most intense attack on a control test sample.

Similar terms to those just enumerated are used for stating conditions of marine growths during the inspections of the control test samples. In these cases, however, the terms are intended to have only a relative value.

All details were noted which were considered to have a bearing on the objective already outlined. Such data were calculated to be of assistance to an engineer in charge of harbour maintenance in any effort directed towards the eradication of marine borers. The facts accumulated by the procedure adopted are essential for determining at least the approximate time of the year when the maximum efforts for extermination should be made, thus obviating the waste of time and material following a decision based on guesswork alone. Also the assembled data indicate the presence of various types of borers, their abundance at specified times, and the nature of the attack which would have to be resisted by any timber used for marine work in the localities covered by the completed observations in this report.

A further use for the detailed facts of inspection presented is their application in cases where borers of similar type and relative abundance of the same may be met with in localities within the port other than the specific ones which have received critical observation. Therefore the reader will appreciate the importance which attaches to a recording of results, stage by stage, as here offered for dissection.

Graphs. Water Conditions.

The full history of each test sample of timber is given hereafter, and from this further deductions may be drawn by the reader or student over and above those specifically mentioned. Graphs have been prepared which specially illustrate the facts established in the text, and these provide an additional guide for quick reference. In the observation details water conditions at each of the two selected stations under present review (temperature excepted) are only stated as average figures. These averages, however, are calculated on the figures available since the inception of the marine borer investigations at the beginning of 1927. Owing to the wider fluctuations in temperature, regular fresh readings were taken, and these monthly records are specially indicated. Temperatures quoted on the graphs, however, are averaged. Check determinations for salinity have occasionally been made, but only when abnormal changes in the state of the water were suspected. Similarly, check oxygen and hydrogen ion quantities were only intermittently worked out. The water temperatures are stated in degrees Fahr., and the readings taken from a thermometer immersed to a depth of 12 inches below the surface.

General Borer Activity.

In observation details of stations, all teredinine borers are referred to under the local vernacular name of Cobra. The crustacean borers, as previously, are given their technical designations.

Respecting damage to turpentine timber, it has previously been recorded that marine borers were responsible for some very definite destruction of test samples (see detailed station histories, initial report, 1932). In the most advanced cases of attack, however, it was the sapwood that suffered during that earlier period of the investigations. Possible confusion on this point has been allayed by subsequent observations prompted by the tests made with standard timber samples, proving that the same conditions of attack are applicable to wharf piles of turpentine. Stress is laid on the fact, because the comparative ineffectiveness of turpentine sapwood is contrary to popular belief.

When the bark is present on turpentine piles, it has been found commonly to form a natural protection against the effective establishment of lodging Cobra larvæ. While the same bark is not entirely proof against the attacks of the crustaceans "Sphæroma" and "Limnoria," it considerably hampers their progression. Further, "Limnoria" will attack the sapwood of turpentine and also the heartwood when access to the latter is possible; other than in exceptional cases, it does not attack the true wood (lying immediately below the sapwood) either in test samples or wharf piles. The same borer is capable of working in any depth of water, but the most intense infestations occur within the limits of the inter-tidal zone. No part of either test samples or wharf piles of turpentine is absolutely proof against "Sphæroma" attack.

The reader will note in the observation details that 100 per cent. destruction was several times registered by Oregon control test samples at Station 32 (Manly), which were attacked by Cobra borers with a maximum diameter measurement of only 3/16-inch. Elsewhere, it is stated that this measurement would represent a growth of three months. Therefore it may be clearly seen that in cases where intense infestation by Cobra borers occurs, destruction to the 100 per cent. stage may be accomplished by animals little more than juveniles in age and dimensions. Definitely it does not require fully-grown Cobra animals to effect ultimate destruction at least in softwood.

Regarding stunting of Cobra borers, it is now believed that this occurs only if a timber be unfavourable because of the presence of natural or introduced toxins.

General ratio of destruction as between the various marine borers in Port Jackson cannot be set out as applicable to the port as a whole. Ratios vary in different localities, as already proved in the detailed observation matter as set out in this and the initial report. An important fact that can, however, be stated, is the relative rate of borer destruction as demonstrated at the two control test stations reviewed in this report. At Station 32 (Manly) the dominant Cobra destruction of the Oregon control test samples registered a rate four times greater than the dominant combined "Limnoria" and "Chelura" attacks at Station 9 (Pyrmont). It is considered that this figure would be maintained in reference to hardwood of any one particular species.

A fortunate feature of the destructive work of the largest crustacean borer ("Sphæroma") in the port waters is its comparatively slower progress, confined to areas of wood between high and near low-water mark. With this form of borer, no part or section of any kind of timber in the form of either test sample or wharf pile is completely immune to attack in Port Jackson. Marked destruction is illustrated by the photos showing the result of "Sphæroma" attack on turpentine piles after five years' immersion. Also, many turpen-

Destruction of Timber by Marine Organisms—continued

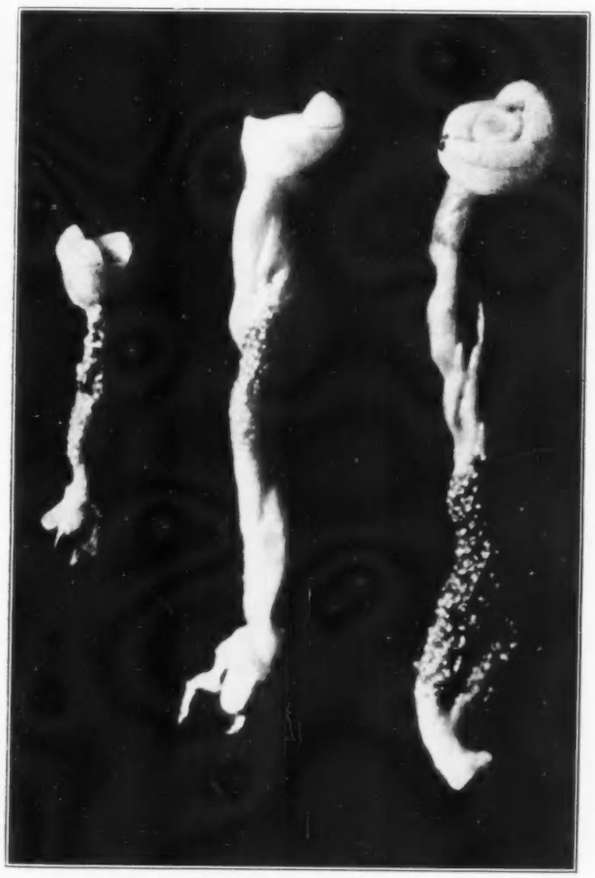
tine piles in Walsh Bay, Port Jackson, have been so reduced in section, mainly by the ravages of "Sphæroma," in fourteen to sixteen years, that they had to be either withdrawn or repaired. In the ports of Newcastle, New South Wales, and Brisbane, Queensland, "Sphæroma" is much more abundant than in Port Jackson; it works faster, and is responsible for increased destruction.

Seasonal Influence

It is not expected that the yearly cycle of attack for any one locality will coincide exactly during any one monthly period in different years. This is because of slight variations in the duration of seasonal influences, when both Cobra and crustacean borers may be affected. The time of the year embracing the most intensive periods of attack, however, will show only slight variation. Some check tests made to date at Station 32 (Manly) show that from November to January almost exact coincidence of Cobra borer activity is obtained. Incidence of borer activity for the months of April and May in different years, however, is likely to show some inconsistence worthy of notice. About this period of the year, as suggested, there is some variation in the time when the maximum temperature is reached and the water begins to lose its warmth.

Behaviour of Crustacean Borers

When the crustacean "Chelura" ultimately joins with the smaller form "Limnoria" in an attack on softwood, it almost invariably hinders for a time the destructive operations of the latter, and when in numbers dominates the attack. "Chelura" is a most active and virile animal, and may on occasions almost completely overwhelm and displace its smaller associate. This is particularly noticeable in the more accessible surface layers of timber. Often the final condition of such an associated attack is to find "Limnoria" occupying only the innermost and less accessible burrows.



Greatly enlarged small examples of sexually mature Teredo pertingens taken from an oregon control test sample, each with developing internal bivalve larvae clearly defined. The smallest and complete example measured one inch in length and $\frac{3}{32}$ inch in diameter. The period of growth covered is slightly less than two months from the time of larval lodgment.

Where Cobra has made an early and intense attack on a control test sample, the rapid internal destruction produces a marked effect on potential intensive external destruction by the crustacean "Limnoria," or "Limnoria" and "Chelura." In such instances the extent of internal destruction by Cobra is not generally apparent from the outside, but often there remains little or no timber fibre further to sustain or encourage the attentions of the crustaceans named. In the circumstances, they almost invariably either gradually die out or desert such a location. This habit is described in the next section.

A fact established in respect to the presence of either thin or thick layers of harder autumn growth in Oregon timber (sometimes termed fine and coarse grain), is the absence of any difference in the rate of destruction by "Limnoria" and "Chelura." Certain it is that the harder layers of wood are temporarily left during the progress of an attack, and the softer spring wood is bored out to quite an appreciable depth. Ultimately, however, the harder layers are undermined, and those portions not consumed are washed away. In this way is equalised the rate of destruction in these two conditions of a softwood timber.

A dissected chip of oregon from a control test sample. The apparently intact surface layer has been removed to show a cross section of the numerous bore holes of young Cobra ½ inch below.

It is to be noticed from reading the observation details of Station 9 (Pyrmont) that the borings of "Sphæroma" in the Oregon control test samples were always ultimately undermined and destroyed by the main crustacean attacks pursued by "Limnoria" and "Chelura." On the surface of hardwood, however, the reverse is the case. Here "Sphæroma," as previously emphasised, readily establishes itself and bores at a more accelerated rate than its smaller relatives. In the latter circumstances the boring rate has not been measured, but the most recent investigations have provided some evidence in respect to softwood, as determined in the observation details of the Dec. Sample (Pyrmont), inspection 1st May, 1933. There it is noted that "Sphæroma" bored in the Oregon control test-piece at the rate of a quarter inch per month, and attained full adult dimensions (approximately half an inch) upon reaching a depth of three-quarters of an inch in a period of three months.

(To be continued)

Presentation of Long Service Certificates.

An interesting event in the history of the Tilbury Contracting and Dredging Company, Limited, took place on Monday, 26th July, 1937, in the Board Room at Tilbury House, Westminster, S.W.1, when the Company's Long Service Certificates were presented to all members of the staff and employees with a minimum of 25 years' service. The presentation was made by the Chairman, The Rt. Hon. Lord Southborough, G.C.B., G.C.M.G., who pointed out that the period of service ranged from the minimum of 25 years to as long as 52 years, and that of the average number of 600 employed regularly by the Company 70 of those were now entitled to receive Long Service Certificates—a splendid achievement, of which any Company might well be proud. Lord Southborough was supported by Lt.-Col. Sir John Chancellor, G.C.B., G.C.V.O., Mr. Cutler Jones, and Mr. Arthur Hughes, the Managing Director.

Legal Notes

Alleged Defective Berth at Scottish Harbour

(By Our Legal Correspondent)

On Wednesday, the 14th July, an interesting judgment was delivered by Lord Keith at the Court of Session, Edinburgh, in the case of the Firth Shipping Co., Ltd., against the Trustees of Aberdour Harbour. The claim was for damages in respect of injury caused to the plaintiffs' steamship " Moray Firth " by reason of a ridge of sand on the bottom of defendants' harbour.

The occurrence giving rise to the legal proceedings took place as long ago as May, 1935. On the 21st of that month, the Firth Shipping Co., of Newcastle-on-Tyne, sent their vessel, the " Moray Firth," to Aberdour to load up a cargo of stone. The vessel berthed alongside a pier in Aberdour Harbour at high tide. As the tide fell she happened to settle down in such a position that her amidship section rested on a hump of sand, whilst her bow and stern hung clear. It is not surprising that she suffered strain, and this was admitted by the defendants. The parties agreed that the damage done amounted to £475. The point at issue was whether, in these circumstances, the Harbour Trustees were liable to the shipowners for the amount of the damage.

The defendants were not a Harbour Board constituted by statute, but were Trustees under a grant from the late Lord Morton, made in 1909, of the Port of Aberdour, by virtue whereof they had the privilege of constructing and maintaining a free port and collecting certain customary dues from those using the port.

The case first came on for hearing before Lord Pitman at the Court of Session in May, 1936. It appeared from the evidence that the state of the bottom of the berth was caused by the propeller of a ship (not the " Moray Firth ") scooping out the sand and forming a ridge. The plaintiffs alleged further that this had occurred at least a month before the 21st May, 1935 (the date of the accident to the " Moray Firth "), and that the bottom of the berth was exposed at low tide, and the danger was therefore apparent and should have been known to the Trustees. The defendants pleaded that they were trustees acting gratuitously, and had no funds for maintaining the harbour in a proper condition, and therefore there was no default on their part such as to render them liable for the damage sustained by the " Moray Firth." The grant placed on them no obligation to maintain the harbour, such as is usually imposed on Harbour Boards by the statutes under which they are constituted. Further, the Trustees did not invite vessels to come to the port, but Aberdour was a free port, used by all and sundry without control by the Trustees.

It was not disputed that the dues received by the defendants were of nominal amount and were spent by the Trustees on repairing the pier. It was also agreed by the plaintiffs that the defendants were not bound to spend on the maintenance of the harbour more than the amount received by them as dues.

Lord Pitman decided that the averments contained in the shipowners' claim were irrelevant, and their suit was accordingly dismissed. The grounds for the learned Judge's decision were that the Trustees had no money available for dredging, or otherwise maintaining the harbour, and therefore could not have prevented the disturbance to the sea-bed. It would be unreasonable to hold them liable for the vagaries of a sandy bottom likely to be shifted by storms and tides or for not intimating that they had not examined the condition of the berth.

The shipowners appealed against this decision, and the First Division of the Court held that there was a case for proof and sent it back for that purpose. It came before Lord Keith.

In the course of his judgment, Lord Keith, as reported in " Lloyd's List " of the 15th July, 1937, referred to the legal duty owed by the holder of a grant of free port to a vessel which took advantage of the facilities provided. Lord Keith said that it was amply vouched by authority that the holder of a grant of free port had to exercise reasonable care for the safety of ships resorting to the harbour, and was liable for a breach of that duty. The defendants said there was no invitation to the plaintiffs to send their ship to Aberdour and no implied representation as to the safety of the berth. But if ships of a certain class were able to make use of the harbour, and, in fact, did so over a period of years without objection, Lord Keith was of opinion that there was an implied invitation by the defendants to the " Moray Firth " to use the harbour.

In his Lordship's opinion, authorities on the question of the limits of the defendants' financial obligations for maintenance of the harbour had no application to the question of their liability for its dangerous condition so long as vessels continued to come into the harbour. The defendants were not entitled merely to fold their arms and take no interest in the safety of those vessels while in the harbour. Were it not for the rule that the holder of the grant of free port was not liable for maintenance beyond the amount of the dues collected at the harbour, his Lordship could see no escape from the view that the grantee was bound to take reasonable care for the safety of the harbour, and was liable in damages for any accident due to his failure to take such care.

In the opinion of Lord Keith, if the deed of grant were insufficient to permit such care being taken, or if from some other reason the holder of the grant chose not to take such care, then he must, at least, give notice to those resorting to the harbour that no precaution for their safety had been taken. Shipowners or seamen could not be expected to investigate the legal character of a port or the state of its finances in order to ascertain the extent of their rights or liabilities.

The authorities referred to by the learned Judge comprise numerous cases decided by the Courts arising out of damage caused to ships through the defects or dangers of harbours.

A case which seems to be in point in discussing the Aberdour judgment is that of " Metcalf v. Hetherington," and probably it was cited on behalf of the defendants at Edinburgh Court of Session.

In the case of " Metcalf v. Hetherington," the Trustees of the Harbour of Maryport were sued by the owners of a vessel, the " James," which was damaged by coming in contact with an accumulation of rubbish in the harbour. Although the Trustees were constituted by statute, they acted gratuitously and apparently without negligence, and the Court found in their favour. Again, in " Thompson v. Greenock Harbour Trustees," the plaintiff's vessel " Albatross" was moored at a certain berth in the tidal harbour of Greenock by direction of the Harbour Master employed by the Trustees. On the " Albatross " taking the ground a stone on the bed of the harbour damaged the ship's bottom. The Court held that the Trustees had taken all reasonable means to make the harbour safe and were not liable. The decision of Lord Pitman seems to follow these cases.

On the opposite side, there is the leading case of " Gibbs v. The Trustees of the Mersey Docks and Harbour Board." In that case the s.s. " Sierra Nevada," when entering the Wellington Dock, Liverpool, struck a mud-bank which had accumulated at the entrance to the dock, and she and her cargo were badly damaged. The owners of the ship and of her cargo sued the Harbour Trustees for failing to carry out their duties, and the defendants pleaded that as they acted merely as Trustees under statute and derived no personal benefit from the management of the docks, they were not liable for an occurrence due to no fault of their own.

The case went to the House of Lords, who held that since the Harbour Trustees levied tolls they were bound to see that their harbour was in a safe condition to the same extent as if they were beneficial owners. They were liable for negligence, and it was negligence if they did not take reasonable measures to find out if the dock was in fact safe. Subsequently the Privy Council approved this decision in the case of " R. V. Williams."

Doubtless, at the present day, all statutory Harbour Authorities and their officials are fully aware of the obligation they are under, not only to maintain their harbour but to take all reasonable steps to ascertain whether they are in a safe condition. But there still exist non-statutory authorities, such as the Trustees of Aberdour Harbour, who might be considered to fall into a different category, since they have no statutory duties placed on them and their funds are inadequate for the proper maintenance of their harbours. The judgment in " Firth Shipping Co. v. Aberdour Harbour Trustees " appears to clear up the law in this respect. Lord Keith decided that there had been negligence on the part of the Harbour Trustees, either in not ascertaining the condition of the harbour bottom, or, if that were not practicable, in failing to give notice to users of the port that the bottom had not been examined and might be dangerous. This decision seems sound in law and reasonable in principle, and it is noted that there is no real discrepancy in the decisions of the two judges on points of law. The only difference is in the interpretation of the facts, namely, whether or not the Trustees' omissions amounted to negligence.

There remains one point which does not appear to have been touched upon at the Court of Session, but which has probably occurred to our readers as of considerable importance. From what source, one wonders, in view of the defendants' lack of funds, are the damages of £475, and the costs of the protracted litigation, to be paid? It would almost seem that the plaintiffs have gained merely a nominal victory and that the position of vessels using Aberdour Harbour is somewhat precarious. On the other hand, it may be inferred, as a result of the Court's decision, that the Harbour Trustees have only to give due notice that they do not guarantee the safety of the harbour and they will be freed from further responsibility for accidents.

Facilities for Coastal Trade at Ports in England, Wales and Scotland

Fourth Section of the Report by Messrs. WILTON & BELL, MM.Inst.C.E.

(continued from page 266)

Berthage and Possibilities of Access to Berths over Longer Periods of Tide

(34) In the preceding part of our report we have dealt with the possibilities of bringing various ports up to certain standards of draught. In this we have not gone into detail as to how much quay accommodation with these draughts should be given at the various ports. At some there is a considerable length of quay available, which either is now or could readily be brought up to standard, whilst at others there is very little, or even none.

On the assumption that a port is placed in a particular category, then the length of quay to be brought up to standard would be fixed by the probable requirements in the immediate future, with possibilities of development allowed for in design, and each port would have to receive separate consideration. It is, however, reasonable to assume that only part of the quayage need be brought to the full standard depths as any coasters of lesser draught could be berthed at the shallower quays, and so these would be utilised. So far as getting to and from a berth is concerned, it would obviously be of advantage to have the quays used by shallower draught coasters, also deeper, as then these coasters could move to and from their berths over a longer tidal period. On the other hand, a very small coaster, when it has taken the ground at a tidal berth where the " layerage " or " bed " is at a very low level, cannot work cargo with the same facility as if it rested on ground at a higher level, more especially if using the ship's own gear.

(35) Where the berths are tidal, there is no artificial restriction as to when a vessel can move to or from a berth. Moreover, provided that the layerage is good, vessels of large capacity take the ground at tidal berths in the ordinary course of trade. At one quay, which we re-constructed some time ago to take additional depth, it was provided that vessels of up to 25-ft. draught should be able to berth taking the ground at low water, and for some years vessels of over 4,000 tons cargo capacity have taken the ground regularly without any trouble ensuing. Oil tankers similarly now take the ground at tidal berths.

A serious objection, however, at some ports to some of the tidal berths is the handicap to easy working of cargo, owing to the vessel at low water resting so far below the quay. This can be minimised by mechanical equipment on the quay and, generally speaking, it appears that tidal berths will meet the exigencies of coasting trade.

(36) Where a wet or floating dock provides the berthage working of cargo is facilitated, but movement to and from the dock is often restricted. This especially holds when the dock has only a single pair of gates at the entrance instead of a lock.

There are instances where conditions in the approach channel are such that a vessel can only get to and from the dock at about high water, and if so, the fact that the dock gates are only opened at a period near to high water offers little, if any, restriction to a vessel's movement. Where, however, a coaster can get to and from the entrance to a wet dock over a greater part of the tidal period, and the level of the dock cannot be lowered to the level of the tide over such a long period, it is of the greatest advantage to have a lock entrance.

A lock entrance is, of course, more costly than a single pair of gates, but the financial advantage it confers on coasters by giving them freer movement and so saving their time may be set off against this. In some ports where the water has a heavy silt content, there is the advantage that a lock entrance by minimising the movement of water into the dock cuts down the silt deposit and the consequent cost of dredging to a notable degree. We had, many years ago, an instance of this, where at a dock used by the coasting trade we substituted a lock entrance for an entrance with a single pair of gates, and the dock authorities stated that avoidance of silting troubles would have almost justified the change, apart altogether from the facility of working vessels in and out of the dock, over a longer period of the tide.

(37) Where the existence of a single pair of gates at the entrance to a wet dock has the effect of hampering the movements of coasters to and from their berths, consideration might be given to converting the wet dock into a tidal dock by disusing the gates or, alternatively, of re-constructing the entrance to form a lock with a second pair of gates.

In some instances the former course might be adopted. It has the advantage of avoiding the cost of re-construction, and would often be quite satisfactory, provided the tidal range was not too great, that the layerage at the berths in the dock was good, and that the construction of the wharves was such as to ensure their stability when the tide was low.

Advantages of More Tidal Information for All Ports

(38) In obtaining such data as are available about the tidal conditions at the various ports, we found that at a great number of these there is very little information as to the depths of water available at different states of the tide, even the levels of high water at some of the minor ports are not known accurately.

To those responsible for carrying on coastal trade of the " tramp " variety, more extensive knowledge as to depths available at these ports at various states of the tide within moderate limits of accuracy would, we were informed, be of the greatest value in conducting their trade.

(39) At the present time, it is quite usual at some of these minor ports to take the nearest large port and deduct from or add a number of minutes to the times of high water at the large port and to allow a number of feet from the heights of high water at that port. This often leads to big discrepancies between the heights assumed and the true heights of water, and gives little or no indication as to what depths are available at various states of the tide. A series of simple records of the heights of water, read by observation on tide poles, on selected tides would enable approximate tidal curves to be constructed for such tides. Tables giving the approximate heights of the tide at the minor port at different hours before and after high water could be worked out from these curves and related to the time and height of high water at the nearest large port at which tidal predictions are available. By this method the depth of water available at a minor port at any period of the tide on any day could be found by ascertaining first, the time and height of tide at the large port on that day, and then referring to the tabular statement for the minor port.

(40) We are, of course, aware that in the Admiralty publications depths of water at high water and the times of high and low water are given for some quite small ports, but not for all, and in some instances these data are not available for fair-sized ports. Even where depths at high and low water are given, it does not furnish a guide as to the depths at intermediate states of the tide, a matter of considerable importance to coasters. Apart from Admiralty data, some information as to relative heights of high water at a great number of ports is given in various publications. In one instance we found, on going through the figures, that the data for one of the larger ports differed from the official figures for that port by considerable amounts. Obviously, in this instance, one could not rely on the accuracy of the figures given for less important ports, when those for a large port were found not to agree with the official figures. Apart altogether from such possible inaccuracies, there does not seem to be any information available in any publication as to heights at intermediate states of the tide at minor ports.

(41) If we could be supplied with such data as we refer to in the latter part of § 39 we should be able to work out approximate tabular statements which we have been informed would be of very considerable assistance to the coasting trade, if made available to them. Local Authorities at the minor ports could readily obtain these data by arranging to note down the tidal levels for selected tides at regular intervals of time throughout each of such tides.

Increased Beam of Coasters and Restrictions by Dock Entrances and Road Crossings

(42) Before passing on from the consideration of access to ports and to their quays at various states of the tide, we desire to draw attention to a most important point. This is the effect on accommodation for the coastal trade of the increasing beam of coasters.

In order to carry a large amount of cargo on a small draught, increased relative beam is necessary, and this is evidenced in new construction.

There are entrances to docks catering for the coastal trade which now are relatively too narrow, and this should be recognised when any scheme of reconstruction proves possible.

(43) There is, however, a further effect of this tendency to greater beam, and that is the restriction imposed by the road crossings on inland waterways traversed by coasters.

In the future a number of these bridges will have to be reconstructed, and some of them no doubt will have to be

Facilities for Coastal Trade at British Ports—continued

strengthened. Where such work is under review, it is of great importance that the requirements of the increased beam of coasters should be emphasised, and that the minimising of obstructions to the free movement of coasting vessels on inland navigations should be kept to the fore.

(44) An example of the restrictive effect of road crossings may be found in the Ship Canal connecting Sharpness to Gloucester. It is about 16 miles in length, 90-ft. wide on the surface, with a depth in the centre of over 16-ft. The full length is without a single lock to impede navigation, and vessels of 14-ft. draught can readily go up to Gloucester. There are, however, a number of bridges of double-leaf type carrying roads across the canal, and we were informed that they are not up to full modern highway loading. The abutments of the narrowest bridge crossing are only 34-ft. apart, so that at present it is considered that vessels should not exceed 32-ft. 6-in. beam. Even with this restriction, vessels carrying up to 1,200 tons of cargo get up to Gloucester.

Crank Level Luffing Crane at Fresh Wharf, London. 30-cwt. working load, 100-ft. maximum radius.

One modern motor coaster of the latest type has a beam of 35-ft., with a draught of less than 14-ft. From this, it will be seen that even now the size of vessel which can get up to Gloucester is limited by old highway construction. This Ship Canal could take modern coasters of much greater cargo capacity if when these bridges are replaced by new bridges up to modern highway standards, the abutments are kept back to a reasonable distance apart. A further point is that there are no less than nineteen bridges in the length of sixteen miles of this canal. It seems reasonable to suggest that the number of these might be reduced by the substitution of fewer bridges, but those bridges up to full modern standards of loading, with advantage both to navigational and highway interests.

(45) Another point which merits consideration occurs in connection with existing road bridges which may have to be re-constructed across such waterways as are or might be navigable by coasters, particularly by light-draught coasters.

The demands of road traffic are naturally for a fixed bridge to be substituted for an existing opening bridge, and often that it should be built at a level only slightly above high water level in order to avoid gradients. If an existing fixed bridge is to be re-constructed, the demand again is often for re-construction at a lower level in order to ease the gradients.

It is, we suggest, most important, from the point of view of existing light draught coastal trade, or of a future development of it, that crossings over waterways that might be navigable, should not offer obstruction to navigation.

When opening bridges require renewal, they should be replaced by bridges which can open to give passage to the widest boat that would be likely to navigate the waterway.

When fixed bridges have to be replaced, even if navigational interest cannot secure the substitution of an opening bridge, the new fixed bridge should give adequate headroom to allow passage to the type of vessel which could use the waterway.

(46) An example of the restriction due to a road bridge occurs on the River Weaver Navigation. At present coasters have a headroom of 60-ft. all the way up to Northwich. The depth of waterway now restricts them to 10-ft. 6-in. draught, but most of it, even up to Winsford, which is about 36 miles above Liverpool by the River Mersey, the Manchester Ship Canal and the Weaver Navigation, is up to 14-ft. draught, and could be brought to that. Access to Winsford, however, which is an important centre of the salt industry, is cut off for all vessels which cannot get under a bridge with 16-ft. headroom by the Hartford Road Bridge, an old narrow stone bridge. This bridge is at the bottom of a steep natural dip in the ground, involving vehicles going down and up a very steep slope, and the new road and bridge to replace the present road and bridge cross the same steep dip. In the scheme for its re-construction, instead of bringing it to the 60-ft. headroom standard of the rest of the navigation and at the same time avoiding the steep gradients on the proposed new road, the suggestion is to perpetuate this solitary obstruction to navigation, though in a modified degree by re-construction with a bridge with only 30-ft. headroom, instead of one giving a headroom of 60-ft. at the crossing of the navigation.

(47) Instances could also be brought forward where new bridges have been built with their decks at such a low level that a light-draught coaster with everything above deck lowered, could not pass the bridge, though otherwise the waterway might allow of its proceeding to places well above such bridges.

Handling of Cargo

(48) The equipment of wharves and quays at the various ports differs greatly as do the speed of working. In specialised cargoes such as coal, pig-iron and ore, forming bulk cargoes as well as grain in bulk, very high speeds are attained in loading, and good figures are also got for discharge.

General cargo naturally shows very much lower figures for loading and discharge. The most difficult cargo to deal with in discharging is stated to be scrap-iron, and no very satisfactory method of getting a high output in dealing with this has apparently been devised.

We propose in the following paragraphs to draw attention to some of the salient points extracted from our memoranda on loading and discharge of cargoes at coastal trade ports. Before dealing with these, we should, however, like to emphasise the importance of rapidity of cargo working at ports where movement to and from berths is restricted by tidal conditions, in order that vessels may not suffer delay after loading is completed.

(49) In the loading of coal, the great bulk is still dealt with by high-level staiths and hoists, though many ports have conveyors to deal with loading. A recent pattern of conveyor with rotary arm commands a length of about 260-ft. of quay. This avoids a good deal of the movement of a vessel which otherwise would be necessary, though moving a coaster is of less moment than moving a large ocean-going vessel.

Where a coaster takes the ground it is naturally an advantage to have coaling appliances that can deliver coal at different points, so that a vessel having more than one hatch can complete irrespective of tide.

At some ports objection is taken by the coasting trade to the use of conveyors on the ground that they are apt to break up the coal to a marked extent, hoists being preferred on this ground.

(50) Balance drops, where the railway wagons are lowered until almost at hatch level, are still in use for loading coasters. We have heard many statements in favour of this old type of coal-loading appliance, especially for the shipment of household coal, as the drop when coal is discharged from the wagon is very little, and breakage is therefore minimised. The slow rate of loading (at one large dock only between 80 and 90 tons per hour) is against it, compared with speeds ranging from 200 to 500 tons per hour for hoists and staiths at various ports, and up to 700 tons per hour, with a maximum of 1,000 tons for conveyors or belt loaders. Coal could not, however, be taken in by coasters at the high rates at which big capacity appliances could deliver it, though at one port a coaster taking 2,400 tons of coal has been loaded from a single hoist in six working hours, and at another, a self-trimmer loaded 1,350 tons in 1¼ hours, the boat having two hatches and two spouts being used for loading.

(51) Amongst handicaps to the shipment of coal to coasters at some wharves and docks is the lack of command by the coal-shipping appliance. There are existing berths, both in wet docks and at tidal quays, where at high water anything except very small coasters could not take in coal, and this must lead to delay. Where alternative suitable coal-shipping berths are not available for coasters which cannot get under these appliances at high water, we suggest that such alterations should be made as to overcome this difficulty.

At some of the smaller coal-shipping places where there may be quite a considerable amount of coal handled, the handicap of having a single coaling appliance is also serious. If any breakdown of this occurs there is delay to coasters waiting to take in coal, whereas the breakdown of one coaling appliance where there are several causes less comparative delay.

Facilities for Coastal Trade at British Ports—continued

As the type of appliance at such ports is often a simple balance tip or balance drop, which is not costly to instal, it appears that if the shipments could be increased, extra coaling appliances of a simple type might be installed with advantage. The present handicap of only a single appliance being available would then disappear. Even without increase of the total amount of coal shipped in the year, a second coal-shipping appliance, where now there is only one, would be of great advantage to coasters, as it would avoid delays to them when there is a rush.

(52) Poor rail connections and small provision of standage near to the coaling appliances are also drawbacks at some of the places, especially at some of the small coal-shipping wharves and docks. An example of this restriction is at Boston Dock, where there are three coal hoists, two up to 20-ton wagon standard and one up to 10-ton wagon standard, and ground adjacent which would allow of additions to the present coal sidings. Rail access, however, is limited to a single line crossing a swing bridge, which must deal with all rail traffic to and from the dock, both coal and general. The swing bridge crosses the River Witham above the dock, and so has not to be opened except for small coasters going to and from some tidal wharves to which there is not very much trade. Even allowing for the bridge not being frequently opened, such a connection to the railway system requires alteration. An additional handicap, we were informed, was that traffic to this single line had to be worked from the railway through a part of the main railway line, thus setting further limits to easy working. At one time a considerable amount of Notts and Derby coal was shipped to London from this port, now it is practically nil.

(53) We noted great variations in speed of loading at different ports. Generally, where there was plenty of standage and the railway wagons worked on and off the coaling points by gravity, the speeds were high. Where the railway wagons coming on to the tips had their direction altered by a turn-table, as is necessary in some places in consequence of the layout of the feeding lines, the speed was naturally less. Where wagons were not worked on and off by gravity, but capstans or locos were employed the speeds again appeared lower. It seems, therefore, advisable that where and when alterations are to be made, that gravity working to and from coaling appliances should, if possible, be provided for with a view to speeding up loading.

Use of anti-breakage appliances varies very greatly. At South Wales ports dealing with soft coal Handcock anti-breakage appliances are in general use. At some of the north-east coast ports anti-breakage appliances of various types are used, but at one port, although provided, no use seems to have been made of it. At several Scottish ports, where conveyors are used for loading, an equipment of anti-breakage boxes was provided.

(54) In discharging coal, speeds varied greatly, not only with the method employed, but even where the same system was adopted. Using tubs or slung baskets worked by ship's own gear, figures were given for discharging into railway wagons or motors as low as 12 tons per hatch per hour, and as high as 20 tons per hatch per hour. Discharging by similar methods to stock pile, the output rose to 25 tons per hatch per hour. The latter figure is as high as the rate of discharge given at another port, where cranes were used to lift the skips or tubs, instead of the vessel's own gear being used.

The highest rate of output was where a grab or transporter was used. One example of this was a wharf equipped with five grab cranes of high command, each taking a useful load of $2\frac{1}{2}$ tons of coal and capable of handling 150 tons per hour. We were given a figure of 95 tons per crane, per hour, as the average from start to finish when discharging a boat. These cranes were not modern ones, nor of the level-luffing type, and were discharging to railway wagon. A large number of other wharves gave figures of 50 tons per hour as the average they could maintain with grabs, these being with cranes taking 25 cwts. of coal in the grab.

(55) Distinct preference for the discharge of coal by skip or tub was expressed at many ports where prevention of the breakage of the coal was of importance, though at others it was not considered that grabs had so much effect in breaking the coal.

The figures in § 54 show that a high rate of discharge per hatch, per hour, can be got by the use of ship's own gear working with skips or tubs. Except for small single-hatch coasting colliers, however, discharge of a vessel would be expedited by shore gear available. More hatches could then be worked at a maximum rate of discharge per hatch, per hour, and so the vessel cleared in a shorter time.

This speeding up of discharge would be of especial value where movement to and from berths was restricted by tidal conditions. It would be of still greater importance where a port is a daylight port, i.e., where navigation is restricted to the hours of daylight as at some ports on tidal rivers. Extreme instances of the value of improved rates of loading and discharge are those ports where a vessel's draught restricts movement to the higher tides and operations commence when the tides are neaping.

(56) In loading pig-iron, very high rates are sustained where the pig comes in boxes or crates, ready for lifting by a crane. At one port, where the pig is handled in boxes with 10 tons to a box by a high command 15-ton crane, 1,000 tons of pig can be loaded to a coaster in six hours. At another port, where the tray system is used with five tons of pig on each tray, 120 tons per crane, per hour, can be got, and a coaster has loaded 250 tons in 50 minutes, using two cranes. The latter rate of dispatch enabled the coaster to get to the berth in a wet dock and away again between the times of opening and closing of the dock gates. Using boards on which $1\frac{1}{2}$ tons of pig-iron is packed per draft and lifted by crane, 40 tons per hour can be got. In unloading pig with the system of working the pig to shovel skips with hooks, 30 to 35 tons per crane per hour was obtained at one port.

(57) Scrap-iron discharge presents the greatest difficulty, unless bundled. At one port, where bundled scrap is discharged at 25 tons per crane per hour, scrap which has to be loaded to tubs is only discharged at 12 tons per crane per hour. For heavy steel scrap, from 15 to 20 tons per crane per hour is attained at another port with open-ended skips. These flat-bottomed open-ended skips, which are used for handling scrap, give fairly good results. The octopus grab is also used, but when dealing with cargo with a considerable amount of flat shearings, its output appeared disappointing. Electro-magnetic cranes are not regarded favourably by various authorities. The rapid and efficient unloading of scrap is one which presents considerable difficulties and does not appear, so far, to have met with a satisfactory solution.

(58) Handling of roadstone, sand and gravel is, as a rule, fairly well provided for by loading by chutes, either direct from wagon or motor, or from hoppers giving good speeds. A more extensive use of storage hoppers with sufficient command to discharge to coasters would be of advantage, as by this method a coaster can take in a full cargo in a very short time.

Discharge at some ports is only by skips or baskets, worked by ship's own gear. Where shore gear is available, rates as high as 30 tons per crane per hour for the discharge of shippings loaded into skips has been got. With grab cranes higher speeds are obtained. At docks where there is an equipment of 5-ton cranes working large grabs, a rate of discharge of 80 to 100 tons per crane per hour unloading to railway wagons is given, resulting in rapid clearance of boats.

(59) In dealing with the loading of china clay, the specialised layout at ports shipping china clay gives high rates of loading. Chutes and belt loaders are both used at Fowey, and give high rates of loading. Even with such a primitive method of handling as picking by hand from trucks and pitching down a chute, a rate of loading of 25 tons per hour is given at one port with a gang of eight men ashore and four men trimming in the hold.

A method adopted at one port where there is not sufficient command to allow of loading from wagon by chute, is to tip direct into the hold. This is done by arranging an adjustable timber roadway leading from the quay on to the vessel and supported on the deck. The motor lorries, which bring the china clay from the "dries," back from the quay on to this roadway so that they can end-tip directly into the vessel's hold.

Another development which should prove valuable was, we were informed, under consideration. This was to erect clay dries actually on quay side either with sufficient command to allow of discharge into vessel's holds or, alternatively, with conveyors to deliver to vessel's holds. This should both lessen costs and tend to more rapid loading.

(60) In the discharge of china clay, grabs, where they can be employed, naturally give the highest rate of discharge, these being as high as 50 tons per crane per hour, but rates as high as 28 tons per crane per hour are obtained with skips, which are filled by shovelling to them in the ship's hold, shore cranes being used to work the skips. The arrangement of delivery by very high command cranes into chutes to the weighing hoppers at the top of a china clay warehouse, as at Preston, appears very convenient.

(61) In the discharge of bagged cement, the best rates are given by shore gear. One port gives, as a record output, just under 60 tons per crane, per hour. Up to 30 tons per crane, per hour is given as an average rate of discharge with cranes on shore. With ships' gear speeds up to 20 tons per hatch per hour are got, one small port returns an output, using ships' gear, of 30 tons per hatch per hour, which is a very high rate using ships' gear alone.

(62) In the handling of slates mechanical equipment is not used, and is generally considered unsuitable. In loading large slates, speeds of $7\frac{1}{2}$ tons per hour per gang are obtained. The gangs are small, each serving one plank, and as many as ten planks could be worked at a time loading 400 tons into a coaster. Unloading by hand, a rate of 25 tons per gang per hour can be obtained, the gang consisting of 20 men. Though at first sight the method of working may appear primitive, it must be remembered that absence of breakage in handling is ensured, and that very careful stowage is required to prevent damage in transit. The total amount of slates loaded to a

Facilities for Coastal Trade at British Ports—continued

vessel in a given time is also fairly high, as so many planks can be worked into one hold. The idea has been advanced of handling slates in crates, which could be stowed in a vessel's hold and lifted in and out by ship's own gear or shore crane, but the loss of stowage space by this method, apart from possibilities of more breakage, appears to outweigh any advantages that might be gained.

(63) It is not necessary to comment on grain-handling equipment at any length. The movement of grain in bulk lends itself readily to mechanical equipment. Even at very small ports there are arrangements to load grain from overhead stores to coasters by spouts. At the larger ports great speeds are obtainable. A notable example is at the grain storage berths at Avonmouth, Bristol. There it is possible to load to a coaster from five spouts. As each spout will deliver 60 tons per hour, it would be possible if the coaster could receive and trim it to load bulk grain at the rate of 300 tons per hour from storage. Where transhipment is required, a floating suction elevator can discharge from an ocean-going vessel to coaster at the rate of 150 tons per hour, or, alternatively, two coasters can be loaded at 75 tons per hour each.

Fleetwood—Wyre Dock Coaling Plant.

(64) At berths where grain is discharged to mill, suction or bucket elevators appear normally available, though in one or two instances at small ports bulk grain was discharged by being bagged and discharged in slings. A common figure for elevator legs discharging coasters is 50 tons per hour. In many of the ports a coaster can only be discharged by one leg of this capacity. It would be of advantage if quicker dispatch could be given by having additional discharging appliances installed.

(65) The shipping of heavy rails and sections, tin plates and similar heavy cargo is adequately provided for at the larger docks and wharves where this trade is carried on and good speeds of loading are obtained, though this is conditioned by the size of hatch of coasters as short hatches necessarily slow down speeds. Steel rails at one port are loaded by shore crane at the rate of 50 to 70 tons per crane, per hour, with 40 tons as a minimum and tin plates, galvanised, plates, etc., at another port at up to 200 tons per hour, using two ships' winches and two shore cranes. Unloading heavy steel sections at another port can be done at over 30 tons per crane. Where these have to be unloaded at ports not laid out with plant, the speeds would necessarily be below this.

(66) In working general cargo to and from coasters, there is great divergence of method and of opinion.

At some ports shore gear only is employed, the view being expressed that with adequate equipment a higher speed of working can be obtained than in any other way. A combination of shore gear and ships' gear is considered at others to be a satisfactory method of working. At some ports, where there is shore gear available to supplement ships' gear, this is used very little, though possibly this is because the extra cost is not considered to give an adequate return. Generally, it is considered that ships' gear, supplemented by shore gear, will give quicker dispatch than ships' gear alone could possibly achieve. At many ports in the West of Scotland the dock authorities take the view that general coastal trade cargo can be dealt with quite expeditiously by ships' own gear and do not provide cranes. On the East Coast of Scotland, a different view was taken, and cranes were available.

(67) Comparisons between different methods of working general cargo are difficult. General cargoes differ greatly, and sizes of hatches vary. At times two, or sometimes even three, falls are worked into one hatch. There is the further complication that speeds of working cargo are affected by the disposal of the cargo on the quay.

(68) Comparisons, however, point to the following conclusions:—

(a) Handling of cargoes by shore cranes, if there are a sufficient number available, gives the highest output per hatch. At one dock where mixed coasting cargo is worked by loco steam crane, cargo is normally unloaded at from 25 tons to 30 tons per crane per hour, two cranes being worked into one hatch, and at times even three, if a vessel has a very large hatch and there is a great rush to clear the vessel. At the same dock loading is carried out at the rate of about 20 tons per crane per hour. At this dock piece-work is the rule.

(b) There is not much difference between the speeds of working cargo which are obtained by the use of one fall of a ship's own gear to a hatch and a single crane to a hatch.

Where a direct comparison can be made between the working of one crane to a hatch and the working of one fall of ships' own gear, the latter give speeds which compare very favourably with the rates of working by a crane. A number of ports give figures of about 25 tons per hour, per crane, with comparable figures of about 25 tons per hour for ships' gear. At one port we were given a record of 36 tons per hour, using only one ship's fall to the hatch. This latter figure was with men working on a time basis, not on piece-work rates.

(c) If a single fall worked from the ship's winch is reinforced by using a crane, the rate of discharge per hatch, per hour, is naturally raised considerably, but not proportionately. As an example of this, the record of 36 tons per hatch, per hour, for the single fall was raised to a record of 45 tons per hatch, per hour, where a ship's fall and a crane worked at the same time into the one hatch.

Similarly, where cranes were used for the unloading of bagged goods, a rate of 38 tons per hour was raised to 46 tons per hour by the use of a second crane working on the same hatch.

(69) At wharves dealing with coasters, we found, in many instances, that the cranes were of an old type, but despite this handicap, that high speeds of working were obtained. The possibility of installing cranes of the high-speed level-luffing type would merit consideration at busy wharves. Where cranes can luff at high speed, experience in dealing with ocean-going steamers points to the advantage to be gained by working by luffing in preference to working by slewing, as in the former method, cranes can work in close proximity without being hampered by each other or by a vessel's masts or deck structures, and so high rates of working per hatch, per hour, can be obtained. Cranes of 30 cwt. lifting capacity seem to be the most suitable for general cargo work. In Scotland the 30-cwt. crane for cargo work is not so much in evidence as in English and Welsh ports, due perhaps to the great extent to which ships' gear alone is employed for ordinary work with cranes only used for special lifts.

(70) Mobility of cranes is also of considerable importance. At a number of ports where the cranes are on rails at the edge of the wharves, the rails are linked up so that cranes can be conveniently moved to give the necessary concentration at any berth. Where there are not these facilities for moving loco cranes, we found a very favourable opinion expressed of the value of small run-about cranes of the petrol-electric or similar type. These were found especially handy in reinforcing ships' own gear.

(71) At wharves where small coasters berth, electric whips deserve consideration. At one port where these have been installed, they were stated to have proved themselves most valuable. They have the advantage that a fall can be taken from them to a derrick on a vessel, and they can thus take the place of ships' winches; barges without power winches were dealt with by this method. The provision of appliances of this type at small coasting ports, now that electric power is generally available, would speed up discharge.

(72) Where there are double-storey sheds at coaster berths, cranes which work from the roof have distinct advantages, especially where they are of the level-luffing type. They leave the quay free from obstruction, and can handle goods to or from either floor of the shed with a minimum of slewing. On the other hand, they require specially strong shed construction to carry the tracks on which they run, which is a drawback to their use. Where they have been installed, we found that they were regarded as very valuable in giving quick dispatch.

(73) An experimental elevator and conveyor installation is being tried at one railway-owned port for dealing with very mixed cargoes. An elevator of continuous type with horizontal trays is rigged into the hold, and feeds on to an inclined conveyor, which carries the goods to conveyor platform moving alongside the railway vans into which the goods are to be loaded. The goods are picked off this conveyor platform as they come abreast the appropriate van. For its special purpose this installation appears as if it should prove successful.

(74) Movement of coastwise cargo inside the sheds is normally by trucking, either power or hand-trucks being used. Opinions differ as to the value of power trucks for moving cargo in the sheds. Where the sheds are not of great width, preference was generally expressed for the use of hand trucks, but where the sheds are very extensive or at a distance from the quay front, power trucks speed up working. At several ports, including some small ports' movement of cargo, was effected by placing a sling of goods on a low wood frame, which is then

Facilities for Coastal Trade at British Ports—continued

raised clear of the ground by the power unit and moved away and lowered in place. This is a convenient way of dealing with goods which are to be moved again.

(75) The type of hand truck employed varies considerably. At one of the large ports a high-wheeled truck is employed, taking a full sling of goods at a time to stack. The height of the platform facilitates the work of off-loading the truck to stack. At another of the largest ports, as well as at a great number of the small ports, the small hand truck moved by one man is used. This type of truck involves breaking up a sling of goods when landed, but amongst ports where it is employed are ports where very high speeds of discharge are obtained. At one port pneumatic-tyred hand trucks were being tried: they appeared to facilitate movement, especially where there were minor unevennesses in the floor surface over which trucking takes place. The port authorities considered that these pneumatic-tyred trucks were a great success.

(76) An even surface for trucking over appears to be of the very greatest importance in easing work and speeding up the movement of cargoes inside sheds, a point to which we allude in a later paragraph.

(77) Mechanical stacking appliances for general coastwise cargo do not appear to be generally considered as having any advantage over hand-stacking, in speeding up the discharge of coasters.

Correction.

In the map of Scotland which appeared on page 263 of the July issue of this journal, the Port of Granton should have been underlined heavily.

Lyttelton Harbour Board, New Zealand

I—Excerpts from Secretary-Treasurer's Annual Report for Year ended 30th September, 1936

As in former years, the principal features of the Report are the year's financial operations and the Board's financial position, the Port's trade and shipping, and a review of the year's activities in giving expression to the policy directed by the Board. As was the case for the year 1934-35, the year ended 30th September, 1936, indicates further recovery from the world-wide depression in trade and finance.

The Board's financial position at 30th September, 1936, without taking into consideration its material assets, may be summed up thus:—

Invested and Cash Assets at par value	£277,503 12 11
Public debt after Conversion of the Board's three loans at 31/3/36 ...	266,400 0 0
Excess of Invested and Cash Assets over Public debt, 30/9/36	£11,103 12 11

At 30th September, 1935, the Public Debt exceeded the Invested and Cash Assets by—£7,786 9 1

The Ordinary Income for the past year was	£102,315 18 9
For the ended 30/9/35 it was	91,056 8 3
An increase of ...	£11,259 10 6

Prospective Harbour Works

In February last, the Board considered a Report submitted by the Engineer on prospective harbour works and the Secretary submitted a financial statement and estimates for two years. The works considered were:—

Widening No. 2 Jetty to provide for additional railway tracks. Estimated cost £16,000.

Strengthening No. 7 Jetty for additional cranes; estimated cost £500.

Lengthening and widening No. 4 Jetty for equipment with electric cranes; estimated cost £18,000. Four cranes for No. 4 Jetty, £24,000.

The Board approved of the work to Nos. 2 and 7 Jetties, but deferred consideration of No. 4 Jetty for further examination of the matter of its permissible length. The Board considered the financing of the approved works and decided "That the Treasurer be and is hereby authorised to repay from the Special Renewal Fund to the Harbour Fund General Account from time to time as may be required, to supplement expenditure from revenue on the Contract for the 10 new Electric Portal 5 ton Cranes and the widening of No. 2 Jetty, sums not exceeding in the aggregate £50,000, or alternatively to retain in cash balance at the Bank to credit of the Special Renewal, Fire and Accident Funds, such amounts as may be required from time to time in those Funds to offset any overdraft in the Harbour Fund created by financing from revenue the works herein mentioned."

Radio Telephony and Radio Direction Apparatus

Following upon the unfortunate marine casualty to the Express Steamer "Rangatira" in heavy weather near Wellington Heads in March last, the Board took up, with the present Government, its earlier proposals for the installation at Lyttelton Heads, or in the Port, of a combined radio-telephone and direction-giving apparatus. It was understood that the matter of radio direction beacons had also been taken up in respect of the Ports of Auckland and Wellington. The Hon. Minister of Marine gave his assurances that the matter would have the Government's early consideration in connection with proposals for the Dominion's chief Ports.

The Report was signed by Chas. H. Clibborn, Secretary, Treasurer, and Chief Executive Officer to the Board.

II—Excerpts from Engineer's Annual Report for 1936

Dredging

During the year, the work of the Suction Dredge "Canterbury" has again been directed towards the maintenance and increase of depth of the entrance channel, the turning basin outside the entrance to the inner harbour and the open parts of the inner harbour.

The annual sounding of the harbour, recently carried out, indicated that the result of the year's work had again been very satisfactory. The minimum depth recorded along the centre line of the channel has increased from 33¼-ft. to 33½-ft. and the average depth of the whole area of the channel and turning basin shows an increase of 4-in. The width of deep water in the turning basin has also been increased.

The results of the last two years' work provide definite evidence of the increased efficiency of the dredge which has resulted from improvements made, including the installation of automatic underfired stokers and alterations to the cutter head.

The total output for the year was 1,205,349 tons, of which 1,010,609 tons came from the entrance channel and turning basin, and 194,740 tons from the inner harbour. The total cost, including repairs and additions, but not interest or depreciation, was 2.52 pence per ton.

Naval Point Reclamation Area

Spoil amounting to 131,040 tons was pumped on to the low-lying area at the southern end of the reclamation by the dredge "Canterbury," at times when weather and tidal conditions were suitable. The level of the ground is now approaching the required height.

Reconstruction of the Oil Tankers' Wharf

This work has been proceeded with throughout the year by the Board's staff, when not engaged in other work, such as crane driving, maintenance and small construction works. The reconstruction of the wharf itself is now nearing completion. All the piles required have been driven and only a small area of the superstructure remains unfinished. The concrete retaining wall behind the wharf has been completed for a length of 200-ft.

The wharf has been in use by oil-tankers throughout the year.

Widening No. 2 Jetty

Plans for widening No. 2 Jetty by 16-ft. on the east side were approved by the Marine Department on April 29th. A contract for the supply of the piles and timber required for this work was let to Messrs. Reese Bros. Ltd., Christchurch, in July, and a first small consignment has come to hand.

Sundry Small Works and General Repairs

A further twenty piles were driven to provide another block of nine berths for yachts and launches.

Three new piles were driven in No. 6 Jetty and three in No. 7 Jetty to replace those weakened by decay.

A new customs examination shelter was built on No. 3 Jetty and electric light was installed in the chief office and in the various shelters on the wharves.

No. 5 Grain Store was wired for the supply of electric power to drive portable elevators.

The Report was signed by Percy W. Fryer, M.Inst.C.E., Engineer to the Board.

The twin-screw hopper barge "Sir Shanmukham," was launched early in July by Wm. Simons and Co., Ltd., complete with all machinery on board and ready for work. The barge has been constructed under the supervision of Sir J. H. Biles and Co., London, for the High Commissioner of India for work at Cochin.

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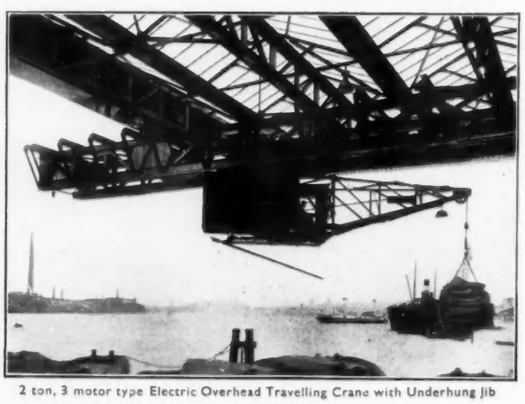

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